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MARTHA SIMPSON: CRC

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STEVE CHAL - CHIEF

CAROL ANDERSON - ADMIN.

ANDREY HENRIKSEN - ADMIN. MST. 857 2545

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① HP PHILANTHROPY PROGRAM GUIDE 1989

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- FOR WHAT?

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IS SEPARATE

Computer Resources: Successfully Seeking Funding and Donations

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**Martha Simpson
Computer Resource Center
750 N. California, Room K-12
Palo Alto, CA 94303
May 11, 1989**

Where to get info on funding sources

San Francisco

Foundation Center
312 Sutter Street
San Francisco, CA 94108
(415) 397-0903
Hours: Mon - Fri 10 am to 4:45 pm
Wed 10 am to 7:45 pm

The Peninsula

Community Resource Library
Peninsula Community Foundation
1204 Burlingame Ave.
Burlingame, CA 94010
(415) 342-2505
Hours: Mon - Fri 9 am to 5 pm

PROPOSALS THAT WON
FILE of SUCCESSFUL
PROPOSALS AVAILABLE

South Bay

Grantsmanship Resource Center
1762 Technology Drive, Suite 225
San Jose, CA 95110
(408) 452-8181
Hours: Tues - Fri 9 am to 5 pm
Mon 9 am to 8 pm

Useful books for funding/donation seekers

Computer Resource Guide for Nonprofits:
Volume II: Funding Source Directory, 3rd edition
Public Management Institute
358 Brannan Street
San Francisco, CA 94107
(415) 896-1900

(1985)

new ed. out by
end of 1989

* Corporate Contributions Guide for Silicon Valley
Santa Clara County Office of Education
100 Skyport Drive
San Jose, CA 95115
(408) 947-6524

\$25

Directory of Building and Equipment Grants
Richard M. Eckstein, researcher
Research Grant Guides, 1988
P.O. 4970
Margate, FL 33063

Foundation Grants Index, 17th edition
The Foundation Center
79 Fifth Avenue
New York, NY 10003
(212) 620-4230

* Guide to California Foundations
Northern California Grantmakers
116 New Montgomery Street, Suite 742
San Francisco, CA 94105
(415) 777-5761

\$20

Proposal Writing Classes

The following is a list of Bay Area organizations offering regularly scheduled classes in proposal writing. Write or call for information on dates, times and fees.

Media Alliance
Fort Mason Center, Bld, D
San Francisco, CA 94123
(415) 441-2557

Support Center/CTD
70 10th Street, Suite 201
San Francisco, CA 941103
(415) 552-7584

Community Resource Library
1204 Burlingame Avenue
Burlingame, CA 94010
(415) 342-2505

Grantsmanship Resource Center
1762 Technology Drive, Suite 225
San Jose, CA 95110
(408) 452-8181

Conducting a needs assessment

Conducting a careful and thorough needs assessment will help you make the right choices when selecting hardware & software for your agency. Use the information gathered in the needs assessment to strengthen your proposal to prospective funders and donors.

If you aren't sure how to conduct a needs assessment, look to these sources for help:

Publications

Computerization Needs Analysis

Computer Help & Information Program
315 West Ninth Street, Suite 1100
Los Angeles, CA 90015
(213) 623-7080

#25-

Classes

Computer Alliance
Fort Mason, Bld. D
San Francisco, CA 94123
(415) 771-1671

Computer Resource Center for Nonprofits
750 N. California, Room K-12
Palo Alto, CA 94303
(415) 493-5171

Support Center/CTD
70 10th Street, Suite 201
San Francisco, CA 94103
(415) 552-7584

Software donations

Two software manufacturers are well known in the nonprofit sector for the breadth of their corporate contributions programs:

Aldus Corporation - maker of **PageMaker** desktop publishing software for the Mac & PC

For contributions guidelines, write to:

Dianne Nicholson
Corporate Contributions
Aldus Corporation
411 First Avenue South
Seattle, WA 98104

Lotus Development - maker of **Lotus 1-2-3**, the best selling spreadsheet program of all time for the PC

For contribution guidelines, write to:

Distribution Manager
Gifts in Kind, Inc. (a UNITED WAY AGENCY)
700 North Fairfax Street, Suite 610
Alexandria, VA 22314

CONTACT LOCAL UNITED WAY & ASK TO
BE PLACED ON THEIR GIFTS IN KIND PROGRAM.

NAELZ (BROOKER HW)
\$500/yr to join
P-Box

PEOPLE TO BE INVITED TO MARCH 17 1979 MEETING, BERKELEY, CA.

Sandy Emerson,
Efrem Lipkin,
Community Memory Project,
1814 Ward Street,
Berkeley,
Ca. 94703.
841-1114, 549-0476

Roger Pritchard,
Network Consultant,
1514 McGee Street,
Berkeley,
Ca. 94703,
527-5604.

Natalie Ziegler/Jim Wilson,
San Francisco Open Network,
3201 Washington, #12,
San Francisco,
Ca. 94115.
922-3118.

Susan Keller,
Community Network for Approp-
riate Technologies,
1100 High School Road,
Sebastopol,
Ca. 95472.
(707) 823-7549

Dennis McCracken, Tony Severa
Synergetic Systems, Ultd,
P.O. Box 183,
Fairfield,
Ca. 94533.
(707) 422-7578.

Stan Commons,
Carolyn Sides,
Faith Whitmore,
NEX:US/Self-Determination,
P.O. Box 126, 2431 Forest Ave,
Santa Clara, San Jose,
Ca. 95052. Ca. 95128.
(408) 984-3184

Bob Cramer,
Resources for Communication,
341 Mark West Station Road,
Windsor,
California 95492.
(707) 542-7819.

Linda Fields,
Jan Ballard,
Oakland Pride,
OCCUR,
1419 Broadway, Suite 802,
Oakland,
Ca. 94612.
835-2660.

Sandy Figone,
County Energy Bank,
Ukiah Community Center,
665 N. State St.,
Ukiah, Ca. 95482.
(707) 462-4357.

Terence Crowley,
Division of Library Science,
San Jose State University,
San Jose, Ca. 95192.
(408) 277-2292.

Phone numbers without area code are (415) area.

add
as
needed
send
"paradigm"
article

May 9, 1979

Tony Severa
131 Highland
Vacaville, CA 95688

For the newsletter:

Dear People:

O I have sent you, somewhat belatedly, the article on networking called "The Basic Paradigm of a Future Socio-Cultural System".

One point that Virginia Hine makes in this article is that the network form allows stable linkages between nodes with very different internal structures and even "apparently conflicting goals and ideological variations." My impression of our meeting on March 17 was that those who met did represent a fairly wide spectrum of structures, goals, and ideologies, while holding in common a belief in the value of networking. I think we should acknowledge our differences at the same time as we celebrate our common bonds. Many of the differences could be characterized as political, and I would welcome a sharper discussion of our individual and organizational politics when we meet again.

The other response I had to the meeting was a feeling that the "process" broke down during the afternoon and the discussion was monopolized by a couple of people. Although time limits are probably a good idea, the presence of the alarm clock was distracting. In a study group I belong to we use the "rotating chair" process in which each speaker calls on the next (who raise their hands) and this seems to work pretty well.

I enjoyed meeting all of you and I look forward to continued connection.

Yours,

Sandy Emerson

6. There should be more low cost primary care.
7. There is not enough support for free clinics.

Nutrition

1. There is a problem of poor nutrition among the economically disadvantaged.
2. Good nutrition is threatened by the presence of pesticides and additives in our food.
3. People in Berkeley and Albany have problems both with over and under nutrition, and there is a problem with getting people to comply with a good diet. (Compliance and motivation to adhere to a good diet.)
4. Programs for teen mothers should emphasize nutritions.

Environments

1. Concern with water pollution.

Emergency Medical Services

1. Albany has a problem with ambulance services.
2. In general there is inadequate emergency medical services for Albany.

Supportive Services

1. Community centers for the homeless, including showers, temporary housing, and a general refuge.

Other

Many of the above problems are the result of excess profit-making in health care.

131 HIGHLAND
Vacaville, Ca 95688
April 4, 1979

Dear Friends,

I was amazed at how much we share in our dream to provide network services to the communities we live in. I thoroughly enjoyed our time together at Roger's beautiful home but as time passed Dennis and I felt that there was a need in us to continue our relationship with as many of you as possible. Some of you have much in common with us and there is so much to learn from each other.

Dennis and I would like to start a small newsletter in an effort to continue to raise issues that we have in common and also to share with each other what is happening in our projects. Distribution of this newsletter will be a project that Dennis and I would be honored to handle. There seems to be two (but not limited to just these) issues that Dennis and I would like to raise as the first items to be in the newsletter: Observations you as individuals had about the meeting we were at and possible reasons and topics for further meetings. In the past few weeks I am becoming more aware of how fast changes can occur that I feel the need to come up with a way to share and document them. I feel the newsletter would be a tremendous aid for all of us.

So, please write to me at the above address no later than April 20, 1979 with your views and I will try and place it in the first issue. Since I have little or no funds it would also help if you could send me three self-addressed, self-stamped envelopes to me with your replies. That will cut down on the costs and I am sure I can provide us with a newsletter at no other cost to you.

The following is a short smattering of some of Dennis's and My observations and questions you may want to react to:

1. How can we best use our network of networkers? There seems to be an enormous potential force of creative synthesis and cooperation among ourselves.

2. How about using keyword - brainstorming sessions for our next agenda when and if we meet as a group again. (Thanks to Roger for this idea.) Perhaps each group could take a topic (such as politics) and report or run a session on it.

3. How about dealing with contingencies - - for example:

How can/could we transmit info and resources in the event of brown-outs, or other large system problems? Do we use C.B., Ham networks, video tape bicycling or something else or a little of everything? 4. How about free association regarding the creative potential around specific topics?

5. How can we be members of each others network without having to put out money that is becoming more and more scarce? Well, these should keep you busy for a while. If you would like to respond to any or all of these feel free to, if you want to add to the list also feel free to. My wordprocessor has the ability to crunch data onto a page so that valuable space is used efficiently. If you cannot make the April 20 deadline then still submit your reactions and we'll place it in the next issue.

If you have any questions, comments or suggestions, call me at 707-446-0417 or write to me.

Sincerely,





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TONY SEVERA

DATA PROCESSING
WORD PROCESSING

COMPUTER SYSTEMS
CONSULTATION

131 HIGHLAND AVE. (707) 446-0417
VACAVILLE, CA. 95688

①

Free University Network -

Denver Open Network -

(2000 items)

500 users - anyone may join for any purpose

Leif - calls it a "general purpose guest facilitator"

\$25/yr. access fee → /weavers (= "networkers").

~~can over~~

(= "information shepherd")

free internet →. ① to adapt to SF - helps that it's already been done -

Denver O.N. - grew by 'word of mouth' -

① advertise widely + rapidly to get diverse interest

② paper first: since this can be seen + will stimulate interest

→ a "first paper" in which space will be free
brochure May 1 (?)

(People Index)

"Libertarian" convention in San Jose -

geographical range: the "greater" Bay area →
(incl. Palo Alto, Marin, etc.)

[Encycl. Britannica] [Amway - sales experience →]
Jim + Natalie Bob + Judy (Ramer)
→ can support selves in ~ 20 hrs./week).

II

Synergetic Systems

(File categories from Whole Earth Catalog +
Propedia III (Encycl. Brit.)) -

looking for a 'data management system' to
bridge seemingly unrelated data.

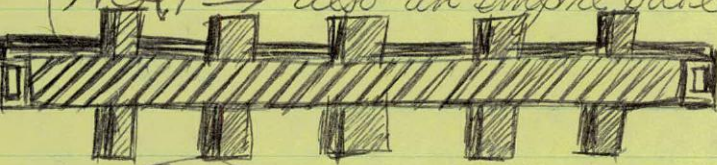
through 4-H, go to Solano County - a-v project, traveling:

Community Network Appropriate Technologies:

- economic implications:

Oakland Pride = "media arm of occur"

(NCAT → also an 'empire building' situation).



SD

1980 - a 'mock election' - demonstrating

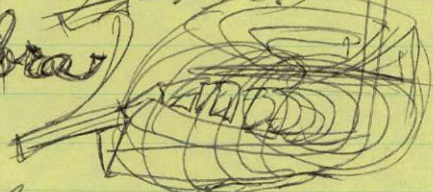
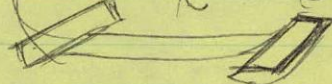
- management consulting → EARTHWORK - called Bob Cramer in - convinced them not to go on to a computer.

Santa Rosa County Public Library
[item file], is what the County got for
\$55,000 per: Boeing.

(maybe needs "management expert") (?) (?)



Boolean Algebra



accession # then the keywords.
have almost always beat computers in time

Carla Annam?

Government Money

1. Susan Keller/Ginny Doyle — often ties into
bureaucratic bullshit —

2. Tony Severa — spell things out —

Open Network vs. given tool (or "L & R")

(18) copies of pamphlet

FEB 23 1979

1514 McGee Street,
Berkeley,
California 94703,
February 22 1979.

Dear Friends,

This an invitation to you to participate in a day long meeting of those involved in developing community information systems, networks and related services in the greater San Francisco Bay area - from San Jose to Ukiah. SATURDAY MARCH 17 is the day, 9.30 a.m. - 5.00 p.m. the time. A suggested agenda is enclosed, as is a list of people invited. The place is my home: address above.

Recently I've noticed that there are a number of groups in the area developing community information services and systems for those services. Many of the groups have been working in relative isolation. One major purpose of the meeting is to introduce people to each other so that mutual support can be developed between them for the future.

Another major purpose of the meeting is to describe and discuss the developed or proposed ideas, systems and support services. Each group is in the same field but each is influenced differently by sources of financial support, group organisation, people served, topics covered, services offered, medium of transmission used, community setting, and so on. It is my experience that, by laying out each project in some detail, getting feedback, and dealing with current issues and problems that others may have dealt with, considerable development can take place in thought and action on the project.

For this reason, it is essential that every participating group send in one or more copies of a project description covering a brief history and the main ideas behind the project, and add a section mentioning the general and specific issues and problems with which the project is now dealing. Please use no more than four pages to do this. It need not be elaborate, but it will save a great deal of time on March 17 if everyone has an idea of what each project is doing. Send it in as soon as possible but to arrive no later than March 7. I will then xerox everything and send everyone who sends a description a complete package.

Since there are several direct costs of putting this meeting on and I have no institutional backing, I'm asking everyone to contribute to those costs on an ability-to-pay basis. I want to cover costs but not to cause people not to come. Direct costs include phone/xerox/mailling/supplies, plus lunch.

If you have any questions, comments or suggestions, call me at (415) 527-5604, or write me at the above address. A map will be enclosed with the package of materials mailed about March 10.

Sincerely,

Roger Ritchard

FEB 22

Dear Sandy,

It's a welcome to
come, but since so
many are invited, I
hope you'll be the only
person from Lawrenceville
Memorial.

I've located Bob Crooner
who should be here part
of the time.

People are being asked
to contribute in the \$5
-7.50 range, depending
on ability to pay, but
some are not paying.
Please send what you can.

Best, Roger

Some comments on the materials submitted for the March
17 meeting

1. The goal of six of the projects, which approach the goal in different ways, is to provide a community-sensitive and interactive information service. The models standing behind the service provision are interesting, e.g. the Open Network model, the decentralised computer-based model, and their variations could be discussed.
2. Some projects aim to be general purpose, but there is a real question to what extent this is possible without diluting the scope to such an extent that, with current resources, the information available will be disappointingly low. Some networks/services are clearly more specialised, e.g. Appropriate Technologies, Self-Determination as a philosophy. Some projects can include education/service exchange where the need is more specific between individuals and a match can be made, e.g. free skills exchanges.
3. The fairly long developmental time line of most of the projects - some having their roots in the early 1970's - is striking. Even the youngest project, the San Francisco Open Network has a model in Denver that goes back over 5 years of operation. This shows that the developmental process is long and frustrating, quite apart from hard to find financing for.
4. Financing, both for the developmental stage and for the early operational stages, is crucial and difficult. Susan Keller is good on this. There are several sources and routes through which money may come and these projects show a wide range. From government grants and contracts, e.g. CETA, with all their red tape and dependency, through guardian angels, to financing the development from other commercial enterprises, and charging membership fees, and a mixture of the above. The balance is likely to shift at different stages; it is affected by political philosophy (of which there is a wide range represented here, from libertarian to socialist); but, generally speaking, it remains a difficult issue at all times.
5. The ideology we have about freedom of information and community service seems to cause problems about making services financially viable, either on a non-profit or for-profit basis. The lack of understanding by outsiders of the labour-intensive nature of the enterprise also seems to contribute. But our own political perspectives also affect our choice of financing routes, and these would be interesting to discuss.
6. A major, generally seen as the major, element in these services, is the information base. Strategies and tactics for building it up, maintaining it, cleaning it out; for the kinds of information to be included/excluded; for indexing it for easy access by various parties; for media, from phone/terminal to locations/documents, through which it will be available: all these vary between projects and are worth comparing for appropriateness.

7. The seventh project, RPC in Windsor, offers technical assistance for development of information services, and Bob Cramer developed a decentralised computer system in the mid-70's which has proved very effective. Community Memory, as part of its overall development, is developing a suitable computer network for this type of service. The logic of each system can, however, be applied to non-computer systems. Technical assistance from the library side can be offered by Terry Crowley. What other types of technical assistance are needed? Outreach strategies for members/users? Political connecting/lobbying? This should be discussed, I think.

8. "Community" is a term with fairly wide reference here. In urban/suburban settings, it seems to mean city-wide, e.g. OCCUR's Oakland Pride project; in rural settings, it usually covers the County; in some instances, e.g. Self-Determination, San Francisco Open Network, it cuts across communities in the geographical sense to 'philosophical' communities and to 'people on the leading edge' who can't get their information/connections by more conventional means.

9. External political considerations in building the support for the services are well-covered by Susan Keller, who also wrote a good paper (Jan. 1979) on this, and more, at Sonoma State University. Internal political considerations seem to me to be most evident at OCCUR, where the actual activities do not correspond in any real way at the moment with the project's job descriptions included in the package. This raises questions about whether city and county politics really permits the development of novel services or whether, with or without financial support, they have to be developed from a more peripheral position, despite the problems that brings.

10. The search for members, for enthusiasts, for guardian angels, and so on, can be considered in its own right. I have found, in other fields, that a core of people, which Dennis McCracken rightly calls 'fanatics', seems to exist, whether consciously planned or not, as a 'natural' phenomenon. The real issue, then, is the extent to which the core is open to input from outside or closes itself up and tries to impose its version on the outside. The big corporations tend to do this, of course. How about us? This raises involvement/financial issues of some complexity, which Dennis also brings out, like Natalie and Jim. Those working under contracts/grants don't have to deal with this so explicitly till the grant threatens to run out. Rather, they have to deal with the dependency issues grants and contracts bring.

11. I am really impressed in general with the quality of the material submitted. My hunch was that groups had developed to the point of being ready for a fruitful exchange. This is really going to happen. See you soon!

RP

1514 McGee Street,
Berkeley,
California 94703,
March 9 1979.

Dear Friends,

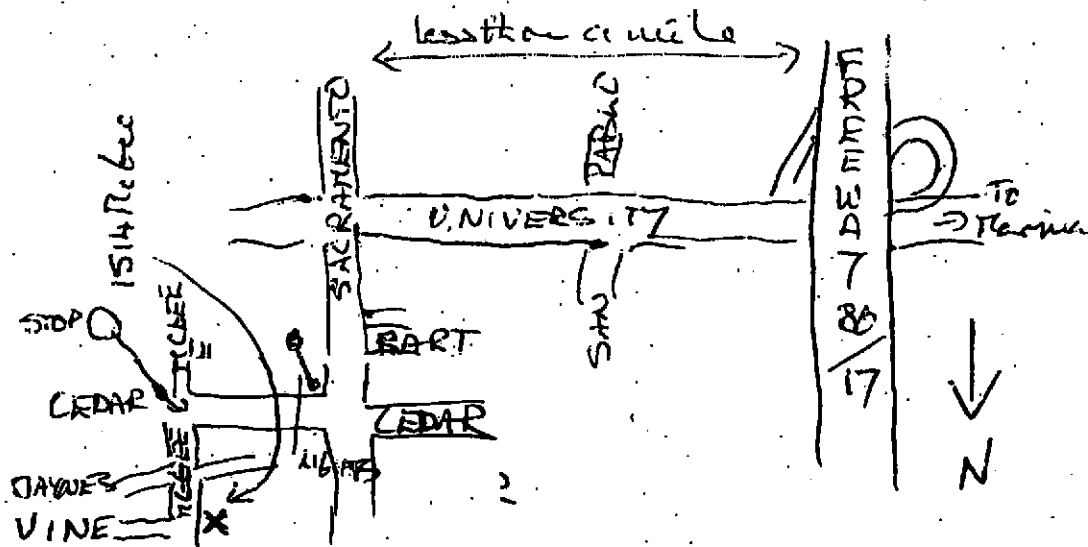
Thankyou so much for sending in your project descriptions. Everything arrived by yesterday. I'm mailing the set out today so that you all have time to read it and think about it. Any commentary I make will follow early next week.

About a dozen people are coming from seven projects. Terry Crowley didn't receive his invitation for some reason and has another commitment, but will send for distribution a write up on his background, ideas and availability. I haven't been able to reach the people in Ukiah. People are starting to call to ask to come and join in. Twelve people are quite enough and so I am saying no to other people. We can consider other people in the future.

The issue of confidentiality of both written and spoken information we exchange has been raised. Several of the projects are in very delicate external and internal political situations. I urge that the written materials not be shown to people outside the group until we can discuss this on the 17th. A much freer and franker atmosphere will exist if we can be sure about keeping "sensitive" information in the group.

If anyone can bring cushions or folding chairs, it would be helpful. Lunch will be provided but you are welcome to bring extra food.

To get to my house, take the University Avenue exit from the freeway 80/17. Go about a mile east towards the hills to a major intersection, Sacramento Street and turn left, or north; there will be BART signs pointing up Sacramento in the direction you want to go. Go about 1/3 mile to the second light. Turn right: this is Cedar Street. Go to the first stop sign - about 2-3 blocks. Turn left on McGee Street. Go 2 blocks to where Vine dead-ends on McGee. My house is light green, on the Bay side, about opposite Vine:



See you!

Roger
Kitchard

Network Meeting
Berkeley 3/17/79

March 14, 1979

Correction on directions: There are no BART signs at Sacramento. The BART sign is at the traffic light before Sacramento, at the Coop, at Acton St., which is only one long block before Sacramento.

Who will be here? Roger Pritchard; Sandy Emerson and maybe Michael Rossman from Community Memory; Natalie Ziegler and Jim Wilson from the Open Network of San Francisco; Susan Keller and Ginny Doyle from the Sonoma Community Network for Appropriate Technologies; Dennis McCracken and Tony Severa from Synergetic Systems Ultd; Carolyn Sides and Faith Whitmore from NEX:US, Self-Determination Network; Bob Cramer and maybe Judy Cramer from RFC; Jan Ballard from Oakland Pride. Sandy Figone from the Mendocino County Energy Bank will not be here because the group feels it is not ready.

Resource materials you can bring. One of the goals of the meeting is to enable groups to exchange ideas, suggestions and materials on issues and problems that come up in the development of community information services. Some of these are listed in some of the information packages sent to you last Friday. Please look at them carefully and consider what materials you can bring with you to help people solve some of the issues and problems.

Some examples: A good indexing system that can be adapted to computers at a later date. The designing and targeting of a questionnaire for various kinds of information. Developing connections with people who will use the services, with people who can politically make the services easier to spread around, and with people you may seem to be in competition with. Plans for a core staff, with skills needed, and for staff to be added in later stages. Directories and directory-type files that have proved to work/not work. Reading lists (and copies) of books, articles and documents you have found especially useful in different aspects of your project development. The logic of decentralised computer systems for community information services.

Income and expenses for the meeting. It is important for me to break even on costs incurred for the meeting. Many thanks to the groups that have sent in checks. Those who have not done so and can afford to do it, please send in a check. At the moment, expenses are somewhat ahead of income. Anyone who asks can have a financial statement for the meeting.

Roger Pritchard

Capsule descriptions of the six projects

by Roger Patchard

March 14 1979

OCCUR's Oakland Pride

NOTE:

The descriptions are by RP
and are subject to
correction by participants

OCCUR is a few years old now and is meant to mediate between citizens, communities and city hall. The Oakland Pride project was apparently put together last fall in 24 hrs when it was discovered that there were unused CETA funds sufficient for 22 positions available. The project description submitted by the Community Communications Specialist - no longer there - does not seem to correspond to what is happening now. In a sense, this is a project without precursors, unlike the other projects, but it does seem to have been redirected by pressures from other directions.

Self-Determination's NEX:US

SD was started in 1975 by people from humanistic psychology and Esalen backgrounds. An early version of NEX:US was tried, as documented in Self-Determination Quarterly Vol. 1 No. 2, pp.31-33, June 1977. This was ~~an~~ assessment/data gathering for files stage. Apparently it was decided the project was pretty big and CETA funds were applied for and got for 1 year from October 1978. The main product of the first year is a Directory in summer 1979, for which the questionnaire is now ready, but a resource file exists and is being increased. SD offers other services to its State-wide network; the NEX:US project has to serve both this network and the County which funds the project. The staff is six people at present.

Community Memory Project

Community Memory is part of a twin project. It goes back to the early 1970's, and there was an experimental version in operation in the mid-1970's. There are about a dozen people involved, paid and volunteer. It combines technology development with community information service design. Funding is said to be from donations.

Synergetic Systems Ltd

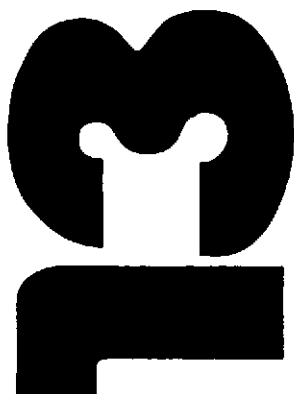
The idea goes back to 1969 and the first trials were about

Project History: see pamphlet, "The Community Memory Project:
An Interim Report"

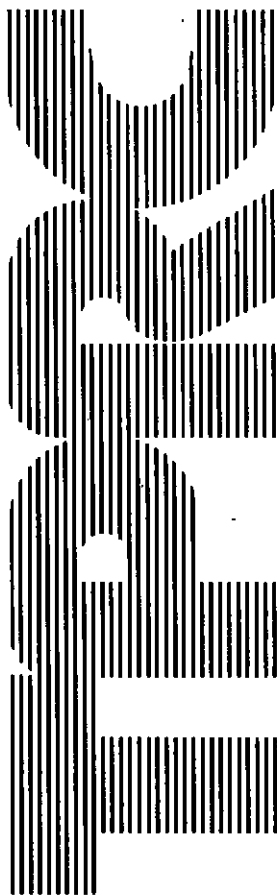
Group Structure and Governance: There are actually two non-profit organizations working on Community Memory and researching and promoting other attempts at community-controlled, egalitarian communications systems. They are: (1) Village Design, which publishes The Journal of Community Communications and is responsible for correspondence, publicity, and community contacts; and (2) The Community Memory Project, which is developing the computer programs (revised standard version) and equipment for the communications system. These two groups work collectively and make decisions by consensus. Both are funded by donations; Village Design is currently seeking funding from foundations to help set up the demonstration node of the Community Memory system. Village Design has 3 salaried staff; Community Memory pays 2-3 computer programmers on a contract basis. All other labor is volunteer (5-6 people). Several of the current group worked on the original Community Memory project and thus have a long history of working together.

Issues and Problems: We meet every week to discuss progress and issues related to the project. Some recent topics have been: 1) What will the system look like to the user? 2) At what point do we set up a community board of directors and get the community involved? 3) Should we ever allow private use of the system? 4) Will the system do anything else except provide for the exchange of information? (i.e., run accounting programs for the 'host' groups who help look after the terminals). 5) Should we charge commercial users more than non-commercial? and so forth. This collective design process seems to work pretty well. Although, in the final analysis, the system's internal functions are determined by programmers' code, we are trying to anticipate how the system can best serve the community, and to design the technology and its 'public image' accordingly. The collective approach to system design seems to keep us healthy, and to make it possible for such a small group to undertake this ambitious project without getting too cut off from the 'real world'.

We don't spend a lot of time talking about 'process' or our feelings about each other. We are generally fairly amiable and respectful of each other, but sometimes tensions remain hidden for longer than they might if we were less guarded. However, the addition of some new volunteers and employees in recent months has stimulated livelier meetings and more focused work. There are too few women in the group! Much of the time I (Sandy) am the only woman around. My background is in English literature and community health care, and my main tasks are putting out the Journal and tending community contacts.



thirteenth
annual
telecommunications
policy
research
conference



**equity:
social &
economic
issues**

airlie house
airlie, virginia
april 21-24, 1985

thirteenth annual telecommunications policy research conference

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Conference Administrative Assistant:
Elizabeth Hall Preston
Workshop Coordinator: Gregory Jones
Conference Host: Hampshire College School of
Communications and Cognitive Science

equity and telecommunications policy research

Activities at this year's Conference are bound together under the common theme, Equity: Social and Economic Issues. Previous Conferences have tended to organize themselves topically, such that each of the many panels addressed a set of important issues that had no necessary relation to other panels. One result has been an occasional sense of fragmentation. This year we have striven for more unity across disciplines and media: Our goal is to promote clearer conceptual thinking about the nature of equity, or fairness, in telecommunications policy research and, no less important, to investigate ways that a concern for equity can become a practical issue for action by policy makers. Equity is significant in many ways. New service providers seek fair access to markets. Users desire an equal chance to influence public policy deliberations. And citizens of the so-called information society deserve an equitable share in the new forms of wealth and power promised by telecommunications technology. Under rapidly changing domestic and international conditions, the extent to which equity can, will or should be achieved is an urgent matter for telecommunications policy research.

We would also like to call your attention to other innovations intended to foster more productive interaction among Conference participants. Everyone is invited to partake in the small-group workshops, which will be a primary opportunity to address the Conference theme. More information about the workshops will be found elsewhere in the Conference folder. Panels have been designed, in terms of their size and the allocation of time, to allow greater discussion between panel members and their audiences. Finally, in keeping with the Conference's focus on North America, Western Europe and Scandinavia, there are a substantial number of non-U.S. policy researchers present. We hope the comparative perspective they bring will benefit us all.

sunday

April 21, 1985

2-6 pm
Foxes Den

Registration

5:30-6:30 pm
East Room

Reception

6:45-8 pm
Airlie Room

Dinner

Speaker: Rep. John Bryant (D-Texas), member, U.S. House of Representatives Subcommittee on Telecommunications, Consumer Protection and Finance

8-10 pm
West Room

Facilitator Training

monday

April 22, 1985

7:30-8:45 am
Airlie Room

Breakfast

9:00-10:30 am
Federal Room

Plenary: Perspectives on Equity: Research Problem, Policy Issue

Oscar Gandy (Howard University)

Dallas Smythe (Simon Fraser University)

Edward Zajac (University of Arizona)

At this opening session, three researchers discuss how equity, as a telecommunications research problem and policy issue, can best be defined and acted upon. They bring the disciplinary perspectives of communications, political economy and economics to this question.

10:45 am-12:15 pm

Morning Session

Studio Room

Determining National Policy: The Power of Foundations and Think Tanks

Duncan Brown (University of Illinois)

Ann Branscomb (Gannett Center for Media Studies)

Discussant: Herbert Dordick (University of Southern California)

In recent years private foundations and research "think tanks" have been significant actors in shaping national telecommunications policy. They have, however, been an infrequent subject of study. This panel assesses their policy influence, with special emphasis on cable TV and public broadcasting.

East Room

Equity Issues in Industrial Structure

Ezio Subissati (Bell Canada)

Sanford Levin (Illinois Commerce Commission)

Discussant: Harry Trebing (Michigan State University)

A key economic policy issue for regulators is what constitutes equitable treatment for incumbent firms and new entrants in the telecommunications services sector. This panel explores competing calls, by established firms, for a "level playing field" and, by new entrants, for the imposition of handicaps on the market power of dominant firms.

Meadow Room

Changing Demographics and New Telecommunications Services

J. Kendrick Noble (Paine Webber)

Thomas Merrick (Population Reference Bureau)

Discussant: Marc Randolph (Community Telecommunications

Development Foundation) and Robert Wade (RMC Communications)

The U.S. population is changing: aging, seeing the growth of minority subpopulations, etc. This, in turn, has implications for the future of telecommunications technologies and services. This panel addresses likely marketing strategies and user patterns that may emerge in the context of a changing population.

12:30-1:30 pm

Airlie Room

Lunch

Speaker: Theodore Brophy (Chairman, GTE Corporation)

1:45-3:15 pm

Afternoon Session

Studio Room

The Viability of Noncommercial U.S. Telecommunications

David Waterman (University of Southern California)

Thomas J. Thomas (Thomas and Clifford)

Discussant: Willard Rowland, Jr. (University of Illinois)

As a matter of national policy, the U.S. has historically been committed to providing noncommercial radio and television. These days, however, reductions in federal funding, experiments in advertising support, and competing new technologies and services all challenge the continuation of noncommercial telecommunications. These currents of change are examined by this panel.

East Room

Implications of Changing Cost Structures for Telephone Competition

Robert Willig and Carl Shapiro (Princeton University)

Dennis Weller (GTE Service Corporation)

Discussant: William Taylor (Bell Communications Research)

This session examines the consequences for competition, particularly in interexchange services, of the deployment of new technologies (e.g., fiber optics) and of changes in cost structures (e.g., access charges) that have occurred as a result of increasing competition and the AT&T divestiture.

Meadow Room

**Transnational Corporations and European Nation-States:
Cooperation or Conflict?**

Jorgen Poulsen (Aalborg University, Denmark)

J. Lowell Ravelsloot (IBM)

Discussant: Hans Peter Gassmann (Organization for Economic
Cooperation and Development)

Western Europe is viewed by many U.S.-based telecommunications firms as a desirable market for their wares. Because many European countries have nationalized telecommunications systems or depend on the sale of their own telecommunications products for economic well-being, they do not always welcome the Americans. This panel explores these sometimes conflicting perspectives.

3:30-5 pm
Various Rooms

Small-Group Workshops

5:15-6 pm
West Room

Facilitators Meeting

6:15-8 pm
Airlie Room

Dinner

Speaker: Kathy Bonk (NOW Legal Defense Fund Media Project)

Evening Session

8-9 pm
Federal Room

Bell Communications Research: The Intelligent Network

9-10 pm
Meadow Room

National Federation of Local Cable Programmers: Hometown USA
Video Festival I

7:30-8:45 am
Airlie Room

Breakfast

9-10:30 am
Federal Room

Plenary: Perspectives on Equity: Report from the Workshops

Facilitators from small-groups workshops report the previous day's discussions, based on panel sessions, of the equity theme. Differences among disciplinary and occupational approaches to the research problem and policy issue are highlighted.

10:45-12:15 pm

Morning Session

Studio Room

Standard Setting and Technological Innovation

Joseph Farrell (GTE Laboratories)

Marvin Sirbu (Massachusetts Institute of Technology)

Discussant: Ian Lifchus (Bell Communications Research)

It is sometimes claimed that the setting of standards stifles the development of innovative technology. Once standards are in place, it may no longer be feasible to create more cost-effective technology. This panel explores the trade-off between the timing of standards-setting and the encouragement of innovation.

East Room

Deregulation and Denationalization: Accountability and Participation Under New Conditions

Nicholas Garnham (Central London Polytechnic)

Guiseppe Richeri (University of Bologna)

Discussant: Vincent Mosco (Queen's University, Canada)

Recent moves in Western Europe and North America to deregulate or denationalize telecommunications industries have fundamentally altered long-established institutional arrangements. This panel considers these changes, especially regarding policy makers' accountability and public participation in the policy process.

Meadow Room

Financing Social Goals

Malcolm Gillis (Duke University) and Glenn Jenkins (Harvard University)

John Wenders (University of Idaho)

Discussant: Rod Dobell (Institute for Research on Public Policy)

From the perspective of economic policy, this panel explores how the goal of universal telephone service can be financed. Examined are both equity and economic efficiency considerations and the historical, political and regulatory influences affecting universal service.

12:30-1:30 pm
Airlie Room

Lunch

Speaker: Nolan Bowie (Aspen Institute Program on Communication and Society)

1:45–3:15 pm

Afternoon Session

Studio Room

Can Universal Telephone Service Survive?

Louis Perl (National Economic Research Associates)
Gerald Brock (Federal Communications Commission)
Eli Noam (Columbia University)
Discussant: Terrence Halpin (Southwestern Bell)

The issue of how market penetration of telephone service would change with the introduction of competition has been debated at great lengths. New entrants, bypass and significant rate changes have all been forecast. This panel examines the impact of rate changes on end users and the costs and benefits of some of the silent features of other changes.

East Room

The Role of the States in Telecommunications Policy

Roger Noll (Stanford University)
Louise McCarren (Vermont Public Service Board)
Discussant: Peter Pitsch (Federal Communications Commission)

This session explores the implications of the restructuring of the telephone industry for federal-state interactions in telephone regulation and for changes in key telephone issues facing state regulators and legislators.

Meadow Room

Transborder Influences on U.S. Telecommunications

Richard Ducey (National Association of Broadcasters)
Frederick Landman (Spanish International Network)
Discussant: Wilson Dizard (Georgetown University)

Countries neighboring the U.S. increasingly influence American broadcasting in cultural and economic terms. This panel explores the growth of foreign-language and ethnic telecommunications services in the U.S. and the push for a pan-American satellite service.

3:30–5 pm
Various Rooms

Small-Group Workshops

5:15–6 pm
West Room

Facilitators Meeting

6:15–8 pm
Airlie Room

Dinner
Final Report from the Small-Group Workshops
Speaker: Nicholas Johnson (Author, Columnist, former FCC Commissioner)

Evening Session

8–9 pm
Federal Room

GTE Laboratories: Telecommunications—Past, Present and Future

9–10 pm
Federal Room

GTE Telemessenger Service

9–10 pm
Meadow Room

National Federation of Local Cable Programmers: Hometown USA
Video Festival II

wednesday

April 24, 1985

7:30-8:45 am
Airlie Room

Breakfast

TPRC

THE FOURTEENTH ANNUAL TELECOMMUNICATIONS POLICY RESEARCH CONFERENCE

AIRLIE HOUSE AIRLIE, VIRGINIA APRIL 27 - 30, 1986

CONFERENCE CHAIR

David Rice
Communications Media Center
New York Law School
57 Worth Street
New York, NY 10013
212-431-2160

ORGANIZING COMMITTEE

Cathy Boggs
TRAC
P.O. Box 12038
Washington, D.C. 20005
202-462-2520

Nolan Bowie
100 La Salle 21G
New York, NY 10027
212-662-1171

Lawrence Darby
Shearson Lehman
55 Water St. F44
New York, NY 10041
212-635-4632

Joseph Farrell
GTE Laboratories
40 Sylvan Road
Waltham, MA 02254

Marilyn Fife
Department of Telecomm.
Michigan State University
East Lansing, MI 48824
517-353-6681

Thomas Guback
Institute for Comm. Research
University of Illinois
Champaign, IL 61820
217-333-1549

Henry Ingle
School of Communications
California State University
Chico, CA 95929
216-895-4015

Frank Kiss
Bell Canada
25 Eddy St. F5
Hull, Quebec J8Y 6N4
Canada
819-776-7835

Ed Lowry
Bell Atlantic
1310 N. Courthouse F9
Arlington, VA 22101
703-974-5909

Willard Rowland
Institute for Comm. Research
University of Illinois
Champaign, IL 61820
217-333-1549

Valerie Sarris
AT&T Communications
295 N. Maple Ave.
Basking Ridge, NJ 07920
201-221-8485

CALL FOR PAPERS AND PANEL SUGGESTIONS

The Telecommunications Policy Research Conference (TPRC) is a multi-disciplinary gathering of researchers and research users in the public policy arena. The goal of TPRC is to provide a forum for exchange of policy-related information and ideas among government, academic and corporate sectors in order to facilitate mutual influence between all these telecommunication decision makers. Conference attendance and paper presentations are by invitation only.

Examples of telecommunications topics explored at recent conferences include:

- Concepts of Telecommunication Deregulation in the Information Age
- Policy Implications of Local Telephone Competition
- Transborder Broadcasting: Foreign Programming on U.S. Radio and TV
- Deregulation and Denationalization: Accountability and Participation Under New Conditions
- ISDN: Issues for the Future Global Communication System
- Copying, Reproduction Costs, and the Supply of Intellectual Property
- Business, Labor, and Microelectronics: Implications and Social Impact
- Technology, Competition, and Pay TV: Perspectives on the Canadian Experience

TPRC is soliciting abstracts of papers, and suggestions for panels, for its 14th annual conference. Submissions for both papers and panels MUST

- deal with topics relevant to policy issues in telecommunications ...
- represent appropriate disciplinary or multi-disciplinary perspectives ...
- draw upon current (i.e. not more than three years old) on-going or new research efforts ...

Studies of an international or comparative systems nature are welcomed.

Abstracts for papers should include specific mention of policy relevance. Abstracts for panels should include a statement of the objectives, scope, and purpose of the panel. Additionally, names of potential panelists, suitability of panelists' background, and topics of panelists' papers should be stated.

All abstracts for papers must be typed, double-spaced, and no more than 250 words. All suggestions for panels must be typed, double-spaced, and no more than 500 words. Submissions should be received by

- June 17, 1985 - from Canada and the U.S.,
- July 8, 1985 - from other countries.

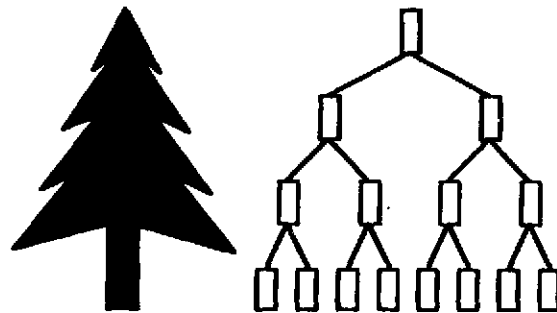
Please address submissions and inquiries to David M. Rice. Telephone inquiries only also will be accepted by members of the organizing committee. Responses to submissions will be mailed no later than September 15, 1985.

CPSR/Portland
PO Box 4332
Portland, OR 97208

F. U = Technology of The Environment
Symposium:

Computers and the Environment: Issues and Opportunities

**Saturday, November 3, 1990
Portland State University
150 Cramer Hall**



Sponsored by Computer Professionals
for Social Responsibility (Portland
Chapter), Portland State University
(Department of Computer Science),
Oregon Graduate Institute
(Department of Computer Science and
Engineering). Endorsed by the
Columbia Group of the Sierra Club.

Computers and the Environment:

Issues and Opportunities

**Saturday, November 3, 1990
Portland State University, Portland, Oregon**

Many of the environmental problems we face today are challenging because they are so complex. Global warming, deforestation, ozone depletion, and similar threats involve complicated mechanisms that operate on many levels simultaneously. Analyzing and understanding them often requires the aid of computing technologies. Although computers are routinely applied to such problems, practitioners and researchers from different disciplines often don't have an opportunity to exchange ideas or techniques. **Computers and the Environment: Issues and Opportunities** will provide a forum for sharing tools and methods.

Selected Topics:

Mapping Old Growth Forests
Peter Morrison, The Wilderness Society,
Seattle

Sharing Technology with the Third World
David Robboy, Project Manager, Unix
Software Development, Intel

How Much is a Fish Worth?
Jeffrey Englin, Environmental Economist,
Battelle Pacific Northwest Laboratory

**Current and Future Environmental
Information Systems for US EPA**
Dan Yurman, Principal Project Engineer,
Idaho National Laboratories

Information Flow in State Government
Connie Revell, Assistant Director for
Communications, Oregon Executive
Department

Modeling Spotted Owl Populations,
Kevin McKelvy, Wildlife Biologist, USFS
Redwood Sciences Lab

**Human and Environmental Impacts of the
Microelectronics Industry**
Peter Cervantes-Gautschi, Campaign for
Responsible Technology

**Geographic Information Systems: Avoiding
the Tyranny of the Subgoal**
William Benz, ComGrafix

**The Impact of Scientific Visualization
Technologies**
David Kerlick, Principal Scientist, Tektronix

Integrated Systems Policy Analysis
Mike Bull, Chief Policy Analysis Section,
Office of Energy Resources, Bonneville Power
Administration

WHO SHOULD ATTEND? Policy makers, professionals, software tool makers, environmental
activists, and interested members of the general public.

COMPUTERS AND THE ENVIRONMENT: Issues and Opportunities

The symposium will focus on tools and issues, addressing questions such as: What tools are available? How are they used and by whom? How could they be improved? Who controls these tools? Who has access to the information they generate? How can biases be minimized when designing applications? How can the political and economic consequences of using of these tools best be handled?

Saturday, November 3
150 Cramer Hall (SW Broadway and Montgomery)
Portland State University

8:00am-9:00am: Registration

9:00am-12:30pm: Morning Session
12:30 pm

Panel 1 ~~Setting the Agenda~~ Modeling and Research
Panel 2 ~~Preserving our Human and Natural Resources~~ From Technology to Policy

12:30pm-2:00pm: Lunch Break

2:00pm-5:30pm: Afternoon Session

Panel 3 ~~Managing Complexity~~ Social Implications
Panel 4 ~~Where Do We Go from Here?~~ Presentations

The day will feature panel discussions, exhibits, and demonstrations. There will be half-hour breaks in the middle of both the morning and afternoon session. Lunch is not provided; a list of local restaurants will be available.

Sunday, November 4
150 Cramer Hall (SW Broadway and Montgomery)
Portland State University

Space will be available for informal meetings on Sunday.

TO REGISTER: Enclose this form in an envelope with your check and mail to: CPSR/Portland, PO Box 4332, Portland, OR 97208. For additional registrants please photocopy this form. Contributions (tax deductible) to defray symposium expenses are welcome. For further information, contact Steve Biederman at (503) 626-1330.

Registration Fees: *or register this weekend by finding Steve Biederman or Erik Nilsen!*

postmarked before 10/22/90:

CPSR member, low income, or
student registration (\$10) _____

Regular registration (\$15) _____

postmarked on or after 10/22/90:

CPSR member, low income, or
student registration (\$15) _____

Regular registration (\$20) _____

Donation _____

TOTAL ENCLOSED _____

Please check here ☐ if you would like
information about display tables or exhibit
space.

Name: _____

Title: _____

Organization/Company: _____

Phone (day): _____

Address: _____

City: _____

State: _____ Zip: _____

Email: _____

Please check here ☐ if you will need help in
finding housing.

Please check here ☐ if you do not wish to appear
in the list of attendees.

CPSR is a non-profit, national alliance of computer professionals concerned about the impact of computer technology on society. As technical experts, we strive to provide the public with realistic assessments of the power, promise and limitations of computer technology.

PLEASE POST A COPY OF THIS REGISTRATION FORM

EXPANDING YOUR HORIZONS

Saturday, March 17, 1990
San Jose State University

Day of the Conference Schedule

The conference begins at 9:00 am Saturday, March 17. You should pick up your conference information packet (containing your assigned workshops) between 8:00 am and 8:45 am on the day of the conference at the Morris Dailey Auditorium, San Jose State University. Groups should arrive before 8:30 am.

- 8:00 Registration begins in Morris Dailey Auditorium
9:00 Welcome
Dr. Gail Fullerton
President, San Jose State University
9:10 Panel: Growing Up a Winner
Neesa Johnson Carmen Ortiz
Sheri Sheppard Fay Umeda
10:25 Snack
10:45-11:45 Morning Workshop I
12:00-1:00 Morning Workshop II
1:00 Lunch
1:45-2:45 Afternoon Workshop
3:00 Closing Remarks, Door Prizes, Conference Evaluation
3:30 End of conference

CONFERENCE SPONSORS

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Math/Science Network
NASA-Ames
San Jose State University—School of Science
Society of Women Engineers
National Semiconductor
as of November 13, 1989

COMPUTER/MATHEMATICS WORKSHOPS

- PENTOMINOES, PUZZLES AND PROBLEM SOLVING**
(Grades 6-8 only)
A hands-on demonstration to explore geometric concepts using pentominoes.
Jan Blasberg, mathematics professor, SJSU
- TILING & TESSELLATIONS OR HOW ESCHER DID IT!**
Look at tiling the plane and how to create "far-out" patterns.
Alice Kelly, Ann Preston, Nedra Shunk, mathematics professors, Santa Clara University
- WHAT IS PI?** (Grades 9-12 only)
That mysterious and ubiquitous number we call pi—where does it come from?
Amy Rocha, mathematics professor, SJSU
- TECHNOLOGY TREATS** (Grades 6-8 only)
Technology is for girls—come and see for yourself! Play computer games, learn calculator tricks, use a video camera and see yourself on TV, explore video disks, or play music on a synthesizer. It's up to you!
Lynne Gray, education professor, SJSU
- MAGIC, MYSTERY AND MATHEMATICS**
Learn some mathematical magic tricks and amazing facts to mystify your friends and family.
Sharon L. Cabaniss, mathematics professor, SJSU
- MAKING AND BREAKING SECRET CODES**
Use basic math to solve substitution and transposition codes.
Lila Kung, mathematician
- FUN WITH 1'S AND 0'S**
Learn how to convert decimal numbers to number systems computers use, and how to add the way a computer does. Get hands-on experience with basic logic gates.
Sharon G. Lum, electrical engineer, IBM Corporation
- DO IT RIGHT THE FIRST TIME!**
Discover how statistics, a branch of mathematics, is helping today's big companies improve the quality of everything from food to automobiles. You can study a process, construct a histogram and plot a control chart for your own process.
Mary Kamm, consultant, Shirtsleeve Seminars
- MATHEMATICS! / MATHEMATICA** (Grades 9-12 only)
See how computers can make mathematics easier and more fun.
Nancy Blachman, president, Variable Symbols
- TAPPING OUT NUMBER THEORY**
Drumming and other rhythmic games will be used to illustrate fundamental aspects of numbers. Connections will also be made to planetary motion and other cyclic phenomena.
Cymra Haskell, Ami Radunskaya, mathematics graduate students, Stanford University

- COMPUTERS: LOVE AT FIRST BYTE**
Find out why so many people just can't live without one. Run some programs you can buy. Write and run your own program.
Adrienne Jardtzy, Sr. programmer, Olivetti
Mary Reha, software engineer, Olivetti
- HOW DOES A COMPUTER ADD TWO NUMBERS?**
An introduction to computer architecture and its basic operations.
Anastasia Saltabida, computer engineer, Hewlett-Packard
- IT'S COMBINATORICS THAT COUNTS**
Combinatorics provides the tools needed for solving problems ranging from school bus scheduling and city planning to genetics, computer science, and space exploration. You will learn how to solve these problems, plus puzzles and magic too.
Tatiana Deretsky, mathematics professor, SJSU

ENGINEERING WORKSHOPS

- MATERIALS MAGIC**
We'll cause steel and rubber to shatter like glass, and perform other amazing experiments.
Sue Gibes, process engineer, Supertex, Inc.
- THE SHAPE OF SPEED**
Discover fluid dynamics and aerodynamic principles by building and racing paper airplanes.
Cheryl Bayle, mechanical engineer, Quasar Engineering, Inc.
- HOW DO YOU ENGINEER CHEMISTRY?**
We'll look at the different ways that chemical engineers use chemistry, from understanding the world around us to making new technology possible.
Sonia Kreidenweis, chemical engineering professor, SJSU
- THE MYSTERIES OF WATER**
Investigate the secrets of acid rain, river flow and soil liquefaction from earthquakes.
Linda Sinderson, student; Thalla Anagnos, Rhea Williamson, civil engineering professors, SJSU
- DESIGNING WOMEN** (Grades 9-12 only)
Computer-aided design workshop.
Lisa Correa, Patty Devincenzi, engineering students, SJSU
- ENGINEERING THE WORLD AROUND US**
Did you know that engineering touches nearly every aspect of our lives? Participate in this hands-on workshop designed to show how simple engineering concepts affect our world.
Lisa Hatamoto, electrical engineer, Society of Women Engineers
- DESIGN YOUR OWN PLANE TO FLY AROUND THE WORLD!**
Choose two cities anywhere on the globe and use a Macintosh computer to design the airplane and determine the ticket price for your trip.
Annette Bianco, Deborah Henry, Sarajo Raman, students, Aerospace Engineering Dept., SJSU

EXPANDING YOUR HORIZONS

WHY SHOULD YOU COME?

- Discover how interesting and fun math and science can be
- Learn about career opportunities for women in mathematics, engineering and science
- Form personal contacts with women working in traditionally male occupations
- Meet other young women interested in science and math

Who is invited?

All 6th to 12th grade young women and interested adults.

What will we do?

The conference begins with an opening welcome and panel of speakers. The rest of the day is devoted to workshops. A workshop is a small class or discussion led by women who have careers in math, science or engineering. Hands-on workshops provide an opportunity for you to experiment in a specific area such as computer science or medicine. Guidance workshops provide general information about career planning. Career workshops are small group discussions with women in scientific careers. You will attend three workshops. We'll provide lunch.

Registration

Register early. Space is limited and only the first 850 students will be accepted. Register by mail using the form on the back of the front panel. Students, indicate 10 workshops on the registration form. We will assign 3 in order of preference if possible. While we'd like you to get your first choices, popular workshops fill up quickly. If all your choices are full, we will place you in other workshops. We think all our workshops are terrific, and you may discover some great careers you hadn't considered. Early registration will help you get your top choices.

Conference Phone Numbers

Information and cancellations: (408) 924-4971 Fee waivers: (408) 924-5099

Registration Fees

The fee of \$8.00 includes lunch. Registration must be postmarked by March 2, 1990. Applications postmarked after March 2 will be returned. There will be no registration at the conference.

Make checks payable to: San Jose EYH Conference
Fee waivers are available. Phone for further information.
Mail your check and your completed registration form to:

EYH Conference
San Jose State University
Dept of Mathematics and Computer Science
One Washington Square
San Jose, CA 95192-0103

You will receive no acknowledgement of your registration unless you enclose a stamped, self-addressed postcard.

Fees will only be refunded if:

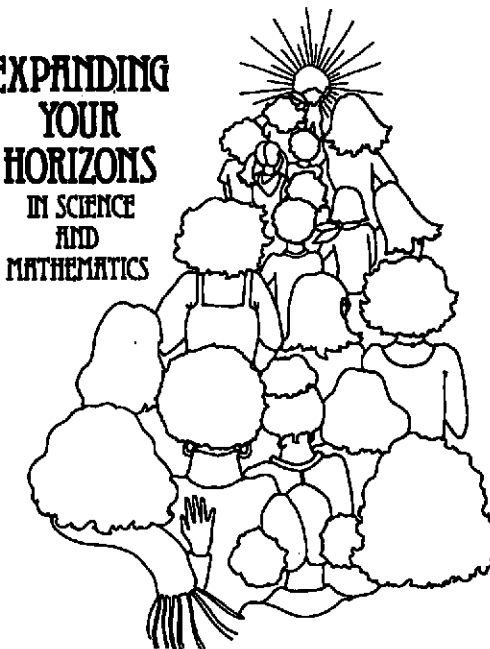
- You call before 5:00 PM March 9 and cancel your registration.
- Your application is received after registration is closed.

Groups: Please send all registration forms and checks (or purchase order numbers) together by February 28, 1990 to ensure that all members of your group are accepted.

EXPANDING YOUR HORIZONS™

IN SCIENCE,
MATHEMATICS, AND ENGINEERING

EXPANDING
YOUR
HORIZONS
IN SCIENCE
AND
MATHEMATICS



Saturday, March 17, 1990
San Jose State University

The twelfth annual conference
for 6th to 12th grade young women
and interested adults presented by
SAN JOSE STATE UNIVERSITY
and the MATH/SCIENCE NETWORK

EYH Conference
San Jose State University
Dept of Mathematics and Computer Science
One Washington Square
San Jose, CA 95192-0103

Non-Profit Organization
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EXPANDING YOUR HORIZONS™

Saturday, March 17, 1990
San Jose State University

STUDENT REGISTRATION FORM

PLEASE PRINT CLEARLY

NAME _____
Last First

ADDRESS _____

CITY _____ ZIP _____

PHONE _____

SCHOOL _____

SCHOOL DISTRICT _____ GRADE _____

What careers are you considering?

STUDENT WORKSHOP CHOICES

Write the letter and number of your first 10 choices: You will be assigned 3.

1st	2nd	3rd	4th	5th
6th	7th	8th	9th	10th

ADULT REGISTRATION FORM

PLEASE PRINT CLEARLY

NAME _____
Last First

ADDRESS _____

CITY _____ ZIP _____

PHONE _____

You may silently observe student sessions your girls are not concurrently attending. If you plan to attend any adult workshops, please circle your choices below (up to three).

A1 A2 A3 A4 A5 A6

21 FACTORY OF THE FUTURE

Learn about computer-integrated manufacturing. Discover how robots and computers will change manufacturing methods in the future.

Felicia Browning, Dung Nguyen, students, Industrial & Systems Engineering Dept., SJSU

22 THE MECHANICAL APPROACH

Watch a rainbow of colors form as materials are stretched. Control a robot arm and perform other mechanical feats.

Shelley Greenacre, Julie Trinh, Jane Walz, students, Mechanical Engineering Dept., SJSU

23 BUILDING A DIGITAL COUNTER

We will wire up a digital counter circuit which will count up and down, and will display the count on a digital display.

Marianne Randles, electrical design engineer, KLA Instruments

24 HOW ELECTRONICS RELATES TO YOUR DAILY LIFE

(Grades 9-12 only)

We will use basic electronic elements to demonstrate how electronics is involved in your daily life. Use an oscilloscope to display the electricity from P.G. & E.

Yuk Yin Leung, Monica Mak, electrical engineering students, SJSU

25 BUILDING DESIGN

How wind, snow, earthquakes and people affect the design of buildings.

Debra F. Jacobs, structural designer, Rinne & Peterson Structural Engineers

26 CATCH A WAVE!

Experiment with the electrical and physical waves engineers harness to solve problems.

Lisa Bonetti, Louise Hornor, electrical engineers, Varian Associates

BIOLOGICAL/MEDICAL WORKSHOPS

27 DESIGNER GENES

How we make and purify new proteins for use in medicine, using genetic engineering techniques.

Cynthia Carilli, biochemist, California Biotechnology, Inc.

28 IN SEARCH OF . . .

Learn how a biochemist can make things "too small to be seen" visible, and find out how doctors use this to diagnose disease.

Christine Miller, biochemist, SYVA Company

Alice Peterson, biologist, U.C. Davis

29 YOU ARE WHAT YOU EAT

Learn how food is digested and changed into body tissue.

Ann Reisenauer, biochemist, Stanford University

Sharon Donovan, nutritionist, Stanford University

30 HERE'S LOOKING AT YOU

Learn about the anatomy of the eye by dissecting an eyeball. Look into each other's eyes with optometric equipment.

Billie Knight, optometrist, Kaiser Hospital-Hayward

31 USING "WESTERNS" TO IDENTIFY THINGS

Learn how a biochemist can use antibodies to visualize molecules. No movie experience necessary!

Beth Hutchins, scientist, Genetech, Inc.

32 BLOOD WILL TELL

Learn what your blood can tell about you in a medical laboratory. What do blood cells look like under the microscope? Learn about blood types and how they are inherited.

Laura Williams, MD, pathologist

33 MEDICAL DETECTIVES

How do health scientists determine what caused a new disease? Explore the field of epidemiology as we track down leads and uncover clues together to get to the bottom of some recent medical mysteries.

Kathleen Roe, health science professor, SJSU

34 PEDIATRICS IS NOT JUST FOR KIDS

Learn about the daily routine of a doctor and how you could become one.

Pat Ferrari, pediatrician

35 ALL CREATURES FEATHERED AND FURRY

How veterinarians provide quality pet care. What is involved in becoming a veterinarian?

Barbara Lee, DVM, veterinarian, Evergreen Veterinary Clinic

36 ECOLOGY ENCOUNTERS

Sample some activities that naturalists use to stimulate interest in and knowledge of the natural world, from touching wild animals to ecology games.

Deborah Jamison, naturalist & teacher, Youth Science Institute

37 BRAIN STORMING

Learn about how your own brain functions. See your own brain waves and try to control them.

Sally Veregge, biology professor, SJSU

38 FOR YOUR EYES ONLY

Learn about vision, the optics of lenses, and how glasses and contacts are made.

Judith Holcomb, OD, optometrist, Kaiser Hospital-Redwood City

Katherine Torrence, optician, Kaiser Hospital-Milpitas

PHYSICAL SCIENCE WORKSHOPS

39 LASERS AND OPTICS

Learn about light by experimenting with lasers, lenses, filters, and fiber optics.

Cathy Keely, Julie Wilker, Diane Hale, Darlene S.-Solomon, engineers, Hewlett Packard

40 SHAKES AND QUAKES

Understanding and preparing for earthquakes.

Sarah Nathe, resource coordinator, Bay Area Regional Earthquake Preparedness Project

41 THE PHYSICS OF COOKING

What makes a microwave oven work? How does it cook your food? Which cookware should you use and why? Find out how physics and engineering can answer these questions for you!

Karen Fant, mechanical engineer, Stanford Linear Accelerator Center

42 LIGHTS, LASERS, ACTION . . .

Everything you always wanted to know about photons, but were afraid to ask.

Leslie Gordon, applied physics graduate student, Stanford University

43 BOWLING BALL PHYSICS

(Grades 9-12 only)
A hands-on demonstration of a freely spinning bowling ball brings alive the principles of rotational dynamics.

Alison Baski, applied physics graduate student, Stanford University

44 LASERS CAN LIGHT UP YOUR LIFE

Participants will get a chance to play with a laser and with a computer graphics display that explains the physics.

Janine Adler, physicist, Stanford Linear Accelerator Center

45 THE PHYSICS OF TOYS

Explore the laws of mechanics with some very familiar objects. Raid the toy box for some physics experiments.

Noa More, applied physics graduate student, Stanford University

46 ELECTRONICS IS A FLASH!

(Grades 6-8 only)
Learn to read a schematic diagram. Understand the function of basic components. Compete with classmates to build your own circuit.

Cheryl Hawthorne, physicist, Stanford University

47 ARE THERE CLAYS ON MARS? WHY DO WE CARE?

Early Earth and early Mars were more similar than are present day earth and Mars. Life may have once been on Mars though it appears not to be there now. Present day Martian soils bear some resemblance to those of burned off Brazilian rain forests. How do we examine Martian soils without being there? What do they tell us about Mars and Earth?

Lelia M. Coyne, chemist, SJSU & NASA Ames Research Center

48 DO IT WRITE! TECHNICAL WRITING FOR THE 1990'S

Explore how an interest in writing can be turned into a successful technical career.

Gail Kesner, Keri Wagner, technical writers, Apple Computer, Inc.

49 ROCKIN' THE BAY IN THE GEO-LOGIC WAY

Managing our environment, earthquakes, landslides, oil, water and more.

Presented by women representing the variety of geologic disciplines and professions in the Bay Area, Association for Women Geoscientists

CAREER WORKSHOPS

50 PATHOLOGY - CUSTOMIZING YOUR CAREER

(Grades 9-12 only)
Both traditional and nontraditional careers for a pathologist.

Elizabeth Ann Saria, MD, pathologist and biochemist, XOMA Corp.

51 WOMEN IN AVIATION

Career opportunities in the overall area of aviation.

Terry London Rinehart, pilot, Delta Airlines

Jeanne McElhatton, flight instructor, NASA aviation safety analyst; chair, Aviation Dept., Foothill College

52 CAREER POLITICS FOR WOMEN

(Grades 9-12 only)

Playing to win the corporate game. How to get ahead in the management pyramid and avoid dead-end careers.

Elizabeth Ann Saria, MD, pathologist and biochemist, XOMA Corp.

53 NURSING: CARING FOR THE HEARTBEAT OF AMERICA

Suzanne Malloy, RN/MSN, nursing professor, SJSU

54 MINORITY WOMEN IN ENGINEERING

A panel of minority women will discuss engineering as a career choice and explain how you can become an engineer.

Virginia Estrella, director, Minority Engineering Program, SJSU

engineering students, SJSU, and a professional engineer

55 ENGINEERING MANAGEMENT

(Grades 9-12 only)

Discussion of the technical and human aspects of managing computer hardware and software projects.

Jane Divinski, engineering manager, Network Equipment Technologies

GUIDANCE WORKSHOPS

56 PLANNING FOR COLLEGE IN CALIFORNIA

(Grades 9-12 only)
Brief overview of California higher education, including preparation needed and opportunities available.

Dea Nelson, director, Relations with Schools, SJSU

57 FINANCIAL AID

(Grades 9-12 only)

Information on the types of financial aid programs available for students.

Rosa Rivera-Sharboneau, financial aid counselor, SJSU

58 CAREER DECISION MAKING

(Grades 9-12 only)

Learn how to explore career options.

Marie Milleage, career counselor, SJSU

59 THE ART OF TAKING CARE OF YOURSELF

(Grades 9-12 only)
Self defense is involved in many aspects of everyday life. An introduction to psychological skills to use in your personal life and the workplace, from making yourself feel comfortable on a casual date to traveling alone on a business trip.

Susan Woodhouse, certified massage practitioner

Marilyn Silva, sales representative, Pacific Cookie Company

WORKSHOPS FOR ADULTS

A1 THE WOMEN IN MATHEMATICS LECTURE PROGRAM

Alice Kelly, mathematics professor, Santa Clara University

A2 CAREER POLITICS FOR THE RECYCLED WOMAN

Elizabeth Ann Saria, MD, pathologist and biochemist, XOMA Corp.

A3 WILL YOUR DAUGHTER BE MATHEMATICALLY PREPARED FOR COLLEGE?

What are the entry requirements in mathematics for the CSU system? What happens to students who are underprepared? How much math will be required for various degrees? All of these questions and many more will be answered.

Susan McClory, mathematics professor, SJSU

A4 WOMEN IN APPLIED SCIENCES: OPPORTUNITIES AND CHALLENGES

Women who enter the applied sciences have many opportunities to excel and the ability to advance, but they also have challenges unique to both the applied sciences and to the fact that they are women. These include communication, family and societal issues. This talk will address some of these opportunities and challenges.

Miriam Salimarch, nutrition & food science professor, SJSU

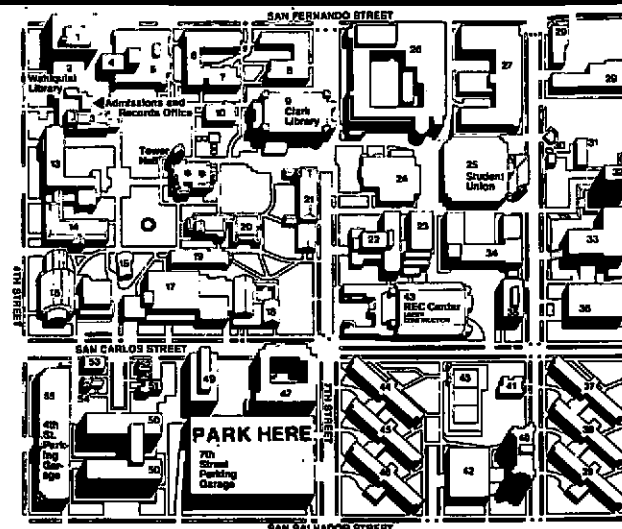
A5 FINANCIAL AID - MEETING COLLEGE COSTS

Financial aid can be confusing, especially for new students. As parents and teachers, you can make the process much easier by understanding the purpose of financial aid and how eligibility is determined.

Rosa Rivera-Sharboneau, financial aid counselor, SJSU

A6 UNDERSTANDING AND PREPARING FOR THE EARTHQUAKES

Sarah Nathe, resource coordinator, Bay Area Regional Earthquake Preparedness Project



•• Morris Dailey Auditorium

SJSU
SAN JOSE
UNIVERSITY

AFTERNOON STUDENT

HANDS-ON WORKSHOPS

26★ DON'T TOUCH THAT STUFF!

Safeley respond to a spill: Suit up, assess, and clean it up.
Carmen Acton, Environmental Specialist,
Pacific Gas Transmission
Barbara Ransom, Environmental Manager, Leslie Salt Company

27★ SHERLOCK HOLMES OF HAZARDOUS WASTE

Unravel the mystery of unknown hazardous materials.
Joy Hirabayashi, Environmental Operations' Group Leader,
Lawrence Livermore National Laboratory
Katherine Chesick, Alameda County Health Department,
Hazardous Materials Section
Terry Chukwueke and Charlene Grandfield, Environmental
Analysts, LLNL
Shari Brigdon, Environmental Technician, LLNL

28★ KEEPING DIRT CLEAN!

Measure how quickly contaminants move through soil down to
the water table, examine a variety of local soils and learn about
the important roles they play in our landscape.
Ellen Williams, District Manager and Amy Evans, Resource
Conservationist, Alameda County Resource Conservation District

29★ DRAW WITH A COMPUTER

Use a Macintosh and HyperCard computer program to draw
pictures and graphs.
Lisa Lemon, Interdisciplinary Computer Science Graduate
Student, Mills

30★ SO YOU WANT TO BE IN PICTURES

Shoot, edit and produce a television news documentary.
Lawrence Livermore National Laboratory Multi Media Team:
Gorgiana Alonzo, Mimi Alford, Dave Dirks, Bob Schanilec,
Ken Wyman.

31 OOBELECK: SUBSTANCE FROM ANOTHER PLANET?

Analyze what it is and what it can do.
Lydia Fox, Manager of the Sanborn Discovery Center, Youth
Science Institute

32 I DON'T KNOW, ASK THE COMPUTER

Use reference materials, including a computer program to
determine implications of a hazardous spill.
Linda Gee, Environmental Manager, LSI Logic Corporation
Shannon Parrish, Programmer Analyst, Chevron
Shari Wetherby, Computer Scientist, Apple Computer, Inc.

33 OIL CAUSES MORE THAN PIMPLES

Clean up an oil spill and discover negative
environmental consequences.
Celia Cuomo, Educator, Lawrence Hall of Science

34 ZAP IT TO ME

Use the VAX computer system to communicate
through computers.
Karina Assiter, Computer Programmer, Chevron
Karilee Wirthlin, Mills Computer Science Major
Andrea Boatright, Assistant Director for Equipment, Mills
Pat Gillenwater, Technical Staff, Ingress Corporation

35 CHIPS!

Learn about the building blocks of a computer.
Jill Okyle, Programmer Analyst, Chevron

36 ANIMALS V. HUMANS

Learn how to determine if a species is endangered.
Sheila Byrne, Biologist, PG&E

37 FEELING SICK?

Learn how to report on science and health news stories.
Deborah Franklin, Medical Reporter, *Hippocrates* and
In Health Magazines

38 ACID RAIN

Test for its presence. Learn what it is and how it affects us.
Sylvia Velasquez, Chemistry Teacher, Lawrence Hall of Science

39 NOT IN MY BACKYARD

Become aware of toxics around you and what you can do
about them.
Kinley Karlsen, Assistant Manager of Environmental Health
and Safety, Stanford University Medical School
Julia Quint, Toxicologist, University of California
Cheryl Pseil von der Heyde, Environmental Program Coordinator,
University of California

40 THE PRESENT IS THE KEY TO THE PAST

Work with gentle animals to unravel mysteries
surrounding dinosaurs.
Gigi Dornfest, Biology Teacher/Educator,
Lawrence Hall of Science

41 ENVIRONMENTAL SLEUTHING WITH THE COMPUTER

Discover why ducks disappeared, causes for global warming
and much more.
Pat Roberts, Designer of Interactive New Media, Media 360
Andrea Silvestri, Design Engineer, Independent Contractor

42 ROCK AND ROLL

Learn how the earth moves during a quake, how to plot an
epicenter and how a seismograph works.
Jane Hall, Docent, Environmental Volunteers

43 IS THIS PLACE ENERGY EFFICIENT?

Explore technologies that contribute to energy efficiency and the
impact of energy use on the environment.
Gloria Nugent, Research Program Manager, PG&E

44 DECOMPOSE A DIAPER AND OTHER LESSONS FROM LANDFILLS

Why do diapers and plastic bags last so long and how can
we help Mother Nature? Answers can be found in the
chemistry lab.
Deborah Watson and Arlene Quiogue, Senior Chemistry
Majors, Mills
Chava Doherty, Laboratory Assistant, San Francisco
General Hospital

45 UNDER THE KITCHEN SINK

Replace hazardous wastes found in your home with
safe substances.
Karen Albertson, Executive Vice President,
Caltest Analytical Laboratories

46 ENVIRONMENTAL WHO DONE IT?

Who polluted? Who is going to pay? You decide.
Sally Benson, Staff Scientist, Lawrence Berkeley Laboratory
Michele Benson-Amram, Environmental Attorney, Landels, Ripley
& Diamond, Attorneys

AFTERNOON STUDENT CAREER DISCUSSIONS

47 HAZARDOUS WASTE LAW

Debra Schmall, Corporate Environmental Lawyer and
Partner with Landels, Ripley & Diamond, Attorneys
ENVIRONMENTAL P.R. AT LESLIE
Lori Johnson, Government and Media Affairs Manager,
Leslie Salt Company
CAREERS WITH EPA
Glenda Dugin, Life Scientist, EPA

48 CHEMISTRY CONTRIBUTES TO WORLD PEACE

Suzanne Monaco, Chemist, Lawrence Livermore
National Laboratory

OPTIONS IN AN ENVIRONMENTAL CAREER

Nancy Carlisle, Management Analyst,
Environmental Protection Agency

49 WHERE THERE'S WASTE, THERE'S JOBS

Ann Kuffner, Technical Manager for Technology
Applications and Commercializations, OHM Corporation
GET IT IN WRITING
Patricia Stuckenschneider, Special Assistant for Research
Communications, Lawrence Livermore National Laboratory

ADULT MORNING PROGRAM

50 ENVIRONMENTAL SLEUTHING WITH THE COMPUTER

Discover why ducks disappeared, causes for global warming
and much more.
Pat Roberts, Designer of Interactive New Media, Media 360
Andrea Silvestri, Design Engineer, Independent Contractor

51 MATH CONFIDENCE FOR ADULTS

Hands-on workshop involving a variety of math concepts.
EQUALS Family Math, Lawrence Hall of Science

52 JOB OPPORTUNITIES AT THE PORT OF OAKLAND!

Cheryl Perry League, Manager of the Equal Opportunity
Department, Port of Oakland

ADULT AFTERNOON PROGRAM

53 WHO DONE IT?

Use DNA fingerprinting to solve a mystery.
Karen Kyker, High School Biology Teacher,
Castro Valley Unified School District

54 MICROBES IN THE ENVIRONMENT

Discover good and bad microbes on your body, in your food, in
the soil.
Chris Carlson, Lab Coordinator, University of California
at Berkeley
Lynn Epstein, Assistant Professor of Plant Pathology, UCB

55 PREPARING FOR AND FINANCING COLLEGE

Zina Jacque, Former Dean of Admission and Financial Aid, Mills

▲ For additional conference information or brochures,
call (415) 447-6458.

DIRECTIONS TO MILLS

Mills is located at 5000 MacArthur Blvd. in Oakland, at the
junction of Highways 580 and 13.

From Berkeley and points north: Take Highway 80 south, change to
Highway 580 at the Bay Bridge interchange. Exit at the second
MacArthur Blvd. exit (6 miles from the interchange) and turn right onto
MacArthur Blvd. The Mills College front gate is on your left.

From San Francisco: Take the Bay Bridge to Highway 580. Exit at
the second MacArthur Blvd. exit (8.5 miles from the Bridge) and turn
right onto MacArthur Blvd. The Mills College front gate is on your left.

From Hayward and points east: Take Highway 580 west. Exit
MacArthur Blvd./High St. Turn left at the stop sign and proceed under
the freeway overpass. Turn left at the stop light. The Mills College
front gate is on your left.

CONFERENCE SPONSORS

Lawrence Livermore National Laboratory
Math Science Network
Mills College
Pacific Telesis Foundation

A Career Conference for 6th to 12th Grade Young Women

EXPANDING YOUR HORIZONS

IN SCIENCE AND MATHEMATICS FOR THE ENVIRONMENT

Saturday
November 3, 1990
Mills College
Oakland, CA

90

REGISTRATION FORM

DEADLINE: OCTOBER 20, 1990

All students and adults planning to attend the conference **must pre-register.**

Check one: ____ Student ____ Parent ____ Educator

Name _____
Please Print

Address _____ Phone _____

City _____ Zip _____

School _____ Grade _____

List the numbers of the Morning Workshops or
Career Discussions that interest you:

List the numbers of the Afternoon Workshops or
Career Discussions that interest you:

Workshops and Career Discussions are assigned on a first come, first served basis. Every effort will be made to accommodate your interests.

▲ Make checks payable to **Math Science Network.**

▲ Mail check and registration form to:

Math Science Network
c/o Sue Stephenson
5460 Cleo Court
Livermore, CA 94550

The registration fee (\$5 for students, \$7 for adults) includes workshops, career discussions, lunch, materials and more.

Conference scholarships are available by calling
(415) 447-6458.

A postcard will be sent to you confirming that you have been registered for the conference.

Printed on recycled paper.

EXPANDING YOUR HORIZONS

IN SCIENCE AND MATHEMATICS FOR THE ENVIRONMENT

Saturday, November 3, 1990
Mills College, Oakland, California

CONFERENCE GOAL

To show you why math and science classes are important and the many careers available in the fields of environmental restoration and waste management.

CONFERENCE SCHEDULE

8:15 - 9:00	Registration Concert Hall
9:00 - 9:15	Welcome
9:15 - 9:50	Keynote Address
9:50 - 10:00	Break
10:00 - 11:15	Workshop or Career Discussion
11:15 - 11:25	Break
11:25 - 12:00	"The Spill" Field near Wetmore Gate
11:45 - 12:25	Lunch Field near Wetmore Gate
12:30 - 1:10	Workshop or Career Discussion
1:10 - 1:20	Break
1:20 - 2:00	Workshop or Career Discussion
2:00 - 2:10	Break
2:10 - 3:00	Closing Session Concert Hall
3:00 - 3:15	Group Picture

KEYNOTE ADDRESS

WOMEN IN ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

Susan Prestwich, Director of Educational Program
Development Division, Office of Technology Development,
Office of Environmental Restoration and Waste Management,
U.S. Department of Energy, Washington D.C.

MORNING STUDENT HANDS-ON WORKSHOPS

1★★ HAZARDOUS SPILLS! WHO'S RESPONSIBLE?

Negotiate a settlement with responsible parties to clean up a hazardous spill.

LaVerne Washington, Environmental Lawyer
Madonna Navaez, Environmental Engineer,
Environmental Protection Agency
Lisa Micheli, Environmental Scientist, EPA

2★★ SCIENCE NEWS

Cover a breaking science news story and report on it.

Glennnda Chui, Science Writer,
San Jose Mercury News

3★ NATIVE PLANTS V. HAZARDOUS SPILLS

Identify plants and soil characteristics and how hazardous materials impact them.

Kathleen Funke-Spiker, Botanist and Groundskeeper,
San Francisco State University

4★ DRAW WITH A COMPUTER

Use a Macintosh and HyperCard computer program to draw pictures and graphs.

Lisa Lemon, Interdisciplinary Computer Science
Graduate Student, Mills
Shari Wetherby, Computer Scientist, Apple Computer

5 CAN I DRINK THIS?

Bring a sample of water from your kitchen faucet, fish tank, or wherever to test and compare its quality with other samples.

Kathy Baylor, Environmental Engineer,
Environmental Protection Agency

6 IS THIS THE BEST PLACE?

Learn how natural resource planning and management protects plants and animals when facilities are built.

Diane Ross-Leech, Supervisor of Land Resource
Management, PG&E

7 SOLUTIONS TO POLLUTION

Learn how pollution impacts the community and how to make decisions based on risks involved.

Linda Yarbrough, Science Teacher and Mentor,
Alameda Unified School District

8 PAPER OR PLASTIC: THE CONSUMER'S CHOICE

Conduct tests on paper and plastic and examine the environmental debate centered around using paper or plastic bags— where they come from and where they end up.

Jennifer Wilson, Science Teacher,
Richmond Unified School District

9 SOME LIKE IT HOT

Environmental Isotopes: Where are they, how do you find them, how do you measure them?

Rebecca Failor, Nuclear Chemist,
Lawrence Livermore National Laboratory

10 GET A "WILD" LIFE

Use radiotelemetry to track harbor seals impersonated by students.

Dianne Kopec, Research Biologist, Ronberg Tiburon Center,
San Francisco State University

11 INDOOR AIR POLLUTION

Learn how to detect it and what to do about it.

Lara Gundel, Chemist, Lawrence Berkeley Laboratory

12 HOW CHEMISTRY CLEANS

Clean dirty water, make a humidity indicator and alka seltzer, and much more with chemistry.

Nora Butler, Analytical Chemist,
Lawrence Livermore National Laboratory

★ *These workshops participate in the "Mock Spill."*

★★ *These workshops participate in the "Mock Spill" and
last all day.*

13 ZAP IT TO ME

Use the VAX computer system to communicate through computers.

Karina Assiter, Computer Programmer, Chevron
Karilee Wirthlin, Mills Computer Science Major
Andrea Boatright, Assistant Director for Equipment, Mills
Pat Gillenwater, Technical Staff, Ingress Corporation

14 "WHO DUN IT IN FRUITVALE?"

Chemically investigate contamination of groundwater.

Nancy Baugher, Physical Science Teacher,
Sunnyvale Junior High School

15 YOU TOO CAN BUILD A HOUSE

Design and build an environmentally sound house.

Deb Smith, Carpenter, Jaime Carlen Company

16 RADIATION AND YOU

Learn where radiation comes from, how it is measured, and the risks associated with it.

Kathleen Shingleton, Health Physicist, Lawrence Livermore
National Laboratory

17 GOOD FOOD, BAD FOOD

Learn how inert mutagens in ordinary food become activated into potential carcinogens.

Alma Trinidad, Biochemist, Lawrence Livermore
National Laboratory

18 ENDANGERED PLANTS

Identify and characterize endangered plants.

Alisya Galo, Museum Researcher, Oakland Museum

19 OOBELECK: SUBSTANCE FROM ANOTHER PLANET?

Analyze what it is and what it can do.

Lydia Fox, Manager of the Sanborn Discovery Center,
Youth Science Institute

20 WHO DONE IT?

Use DNA fingerprinting to solve a mystery.

Karen Kyker, High School Biology Teacher,
Castro Valley Unified School District

21 MICROBES, MOTHER NATURE'S HOUSEKEEPERS

Learn how microorganisms break down pollutants, generate energy and recycle debris and garbage.

Shanna Yonenaka, Microbiologist and Biology Lecturer,
San Francisco State University

22 WHAT'S IN THIS WATER?

Bring a sample of water from your kitchen faucet, fish tank, or wherever to test and compare its quality with other samples.

Lucy McMillan, Senior Civil Engineer, PG&E

23 MICROBES IN THE ENVIRONMENT

Discover good and bad microbes on your body, in your food, in the soil.

Chris Carlson, Lab Coordinator, University of California
at Berkeley

Lynn Epstein, Assistant Professor of Plant Pathology, UCB

MORNING STUDENT CAREER DISCUSSIONS

24 ENVIRONMENTAL MANAGEMENT CONSULTING AND RISK MANAGEMENT

Michelle Benz, Safety Unit Manager and Environmental
Consultant, M&M Protection Consultants

ENVIRONMENTAL HEALTH SCIENCES: TOXICOLOGY

Yi Wang, Environmental Biochemist and Toxicologist,
California State Department of Health Services

ENVIRONMENTAL EDUCATION

Sandy Bredt, Interpretative Specialist for Natural Sciences,
Oakland Museum

25 THE DYNAMICS OF ENVIRONMENTAL CAREER CHANGES

Kinley Karlsen, Assistant Manager, Environmental Health
and Safety, Stanford University Medical School

ENERGY FROM UNDERGROUND

Sally Benson, Staff Scientist, Lawrence
Berkeley Laboratory

3 Leading Soviet Technologists

The conference style seminar will be given by three members of the "USSR Ministry of Instrument Construction, Means of Automation and Control Systems."

Professor Georgij Jordan — A Doctor of Technical Sciences from Moscow State University, is currently Director of the State Scientific Research Institute of Heat-Power Engineering Instrument Making, "NIIteplopribor". He is also a member of the Presidium of the S. I. Vavaliyov All-Union Scientific-Technical Society of Instrument Construction, and has published more than 60 papers.

Dr. Boleslav Volter — A Doctor of Sciences from the Leningrad Institute of Instrument Construction, is currently Department Head of the Central Scientific Research Institute of Complex Automation. He has published over 50 papers and numerous reports including 2 reports at the Congress of the International Federation of Automatic Control in Basel (1963) and London (1966).

Professor Boris Timofeev — A Doctor of Technical Sciences from the Georgian Polytechnical Institute and a Corresponding Member of the Academy of Sciences Ukrainian SSR, is currently Director of the Institute of Automation, and Deputy Chairman of the Administration of the "Zhaniya" Scientific Society of the Ukrainian SSR. An honored Scientist of the Ukrainian SSR he has lectured in Czechoslovakia, Yugoslavia, Japan and the G.D.R. and has published over 160 papers.

Other Conferences

In future conference style seminars, a broad range of Soviet technology will be covered. Some of the subjects to be covered and the dates for the conferences are shown below:

Subjects	Lecturers	Dates (Tentative)
The Use of Computers in the USSR Higher Education System	Prof. I. T. Goosev Prof. A. Y. Savaljev Prof. V. P. Vlasov	November, 1976
Application of the conjunctive function theory to the solution of various meteorological problems	Ministry of Hydrometeorology	1977
Solution of equation utilizing the hydro-thermodynamic method of splitting applied to the numerical prognosis problems	Ministry of Hydrometeorology	1977
Economic Planning & Forecasting at the national and branch level in the USSR for long and medium terms	Academy of Sciences of the USSR	1977

ТЕХНОЛОГИЯ УПРАВЛЕНИЯ ПРОЦЕССАМИ В СОВЕТСКОМ СОЮЗЕ

*PROCESS CONTROL TECHNOLOGIES IN THE SOVIET UNION

The first in a series of three-day conference style seminars led by Soviet scientists and engineers and sponsored by Control Data Corporation to promote the exchange of basic technology between the Soviet Union and the United States.



8100 - 34th Avenue South. Mailing Address - Box 0, Minneapolis, Minnesota 55440. Tel.: (612) 853-3575

Registration limited — enroll today.

State-of-the-art of technology in the Soviet Union – what opportunities does it present for your company.

The Soviet Union is investing heavily in research and is keenly interested in moving its technology from the laboratory into industry. Now they desire increased licensing arrangements with U.S. companies.

To assist in achieving this goal leading Soviet scientists and engineers will conduct conferences in the United States. These meetings are sponsored by Control Data's Institute for Advanced Technology.

If you would like to learn about state-of-the-art technology in the Soviet Union to evaluate potential opportunities for your company, make plans now to attend these seminars.

The first of these seminars, entitled "Process Control Technologies in the Soviet Union", should be of great value to those involved in the field of industrial process control.

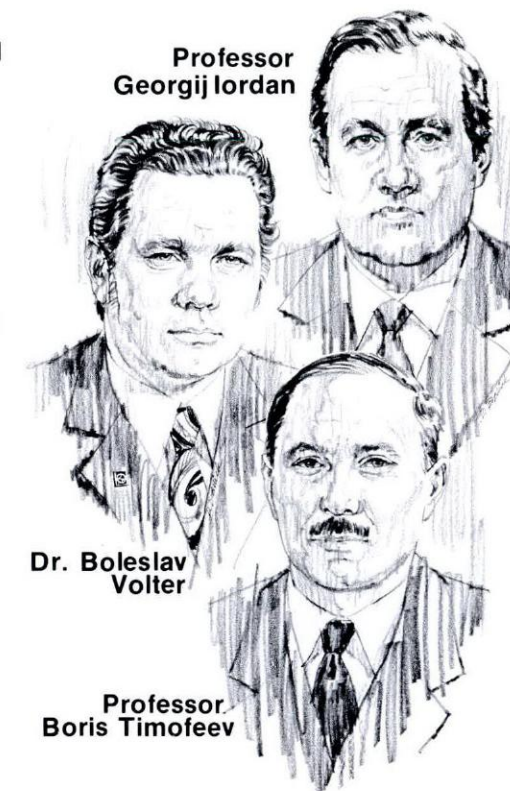
Lectures will be conducted in Russian with simultaneous English translation with ample opportunity provided for questions from attendees about Soviet process control technology.

The Seminar

The effective control of a modern chemical, metallurgical or power plant, depends on the technological solution of the following problems:

- Measurement of the pertinent process variables, (temperatures, pressures, flowrates, liquid levels, etc.) as accurately as possible with as little time lag as possible.
- Conversion of the measurements to a form suitable for processing by a computer.
- Processing of these data in a computer-controller.
- Formulation of the control laws to achieve the desired results.
- Transmission of the control signals to the various devices that regulate the plant.

The three seminar speakers will address themselves to the solution of these problems.



TECHNOLOGICAL DEVELOPMENTS IN MONITORING AND CONTROLLING A LARGE-SCALE PLANT

Professor G. G. Iordan, who has had a primary interest in the measurement and control of state variables in sub-systems for the past 30 years, will present the latest developments in the construction of instruments for measuring process variables; processing the collected information and developing the control action; and implementing the control through control actuating mechanisms. In particular he will discuss the development of:

- the NII TEPLORIBOR "SAPPHIRE", a lightweight, reliable, safe strain gage semiconductor measuring transducer of the silicon on sapphire type;
- a sophisticated computer-controller system (AXESR);
- advanced control actuating mechanisms.

AUTOMATIC CONTROL OF A LARGE-SCALE POLYETHYLENE PLANT

Dr. B. Volter will discuss the development of a sophisticated control system (ICS) for a polyethylene plant. The main functions of this highly successful system ("POLYMER 50" in continuous operation since 1974) are the following:

- Provides a centralized data acquisition facility (750 analog, 700 digital inputs).
- Processes the information and, using a mathematical model of the plant, develops on-line control actions.
- Provides complete supervision of both the technical and economic performance of the plant.
- Allows for completely automatic start-up, shut-down, change-over operations.

AUTOMATIC CONTROL IN METALLURGICAL PROCESSES

Professor B. B. Timofeev will discuss the automation of a steel-rolling mill in Nizkniy Taghil. This plant produces wide-flange H beams with heights from 200 to 1000mm and flanges up to 420mm wide. The automated control system is designed according to the hierarchical principle and comprises a number of regional automation systems made up of microprogrammed automated devices and seven computers-controllers utilizing the Soviet M6000 and M7000 systems.

Registration

We expect an excellent turnout for this first conference style seminar led by Soviet scientists and engineers. But the very nature of the conferences requires that we limit attendance. So we urge you to complete the Registration Form today. Or, call the Institute For Advanced Technology at (301) 468-8576 and ask to speak to the Executive Registrar.

Fee

The full registration fee, which includes lectures, luncheons, coffee breaks, workbooks and seminar materials, is \$750. Orders placed by corporations must be accompanied by a purchase order. Orders by individuals are payable in advance. Checks should be made payable to The Institute for Advanced Technology.

Cancellations

For all cancellations received less than 2 weeks before scheduled conferences there is a \$50 cancellation fee. (We reserve the right to cancel the conference or amend the syllabus).

Locations

The conference style seminars will be conducted at the hotels shown below. The cost of hotel rooms is not included in the tuition. IAT does not arrange hotel reservations, however, the hotels will hold a block of rooms for participants until two weeks before the conferences. Hotel reservation cards will be forwarded with registration confirmations. Please contact the hotels directly for reservations, mentioning IAT; Control Data Corporation; the conference; and dates attending.

City		
Washington, D.C.	Oct. 6, 7, 8	Ramada Inn of Alexandria 901 N. Fairfax St. Alexandria, VA 22314 (703) 683-6000
Houston, Texas	Oct. 11, 12, 13	Stouffer's Greenway Plaza 6 Greenway Plaza East Houston, TX 77046 (713) 629-1200
San Francisco, Cal.	Oct. 18, 19, 20	Miyako Hotel Post and Laguna Streets San Francisco, CA 94115 (415) 922-3200

Telecommunications Technologies For the Non-Engineering Professional

A Comprehensive Overview and Update

A Two Day Seminar

San Francisco, CA	—	January 3-4, 1991
Columbus, OH	—	January 14-15, 1991
Minneapolis, MN	—	January 16-17, 1991
New York, NY	—	January 28-29, 1991
Washington, DC	—	January 30-31, 1991
Boston, MA	—	February 5-6, 1991
Detroit, MI	—	February 7-8, 1991
Denver, CO	—	February 19-20, 1991
Seattle, WA	—	February 21-22, 1991

— See additional seminar dates in your area on page 14

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DATA-TECH INSTITUTE

Lakeview Plaza • P.O. Box 2429
Clifton, New Jersey 07015

(201) 478-5400

FAX (201) 478-4418

Dear Colleague,

Finding time to stay on top of the latest changes and developments that occur in our professional lives is an absolute necessity. Yet sometimes, it's quite difficult. Nowadays it seems technological breakthroughs are occurring so quickly, that the professional knowledge and expertise we possess is virtually outdated, even before we can apply it.

At Data-Tech Institute, we're helping business professionals, just like you, succeed every day. Our expert instructors supply you with comprehensive coverage (see pages 5-10) of practical, no-nonsense topics, that are guaranteed to produce immediate results for you and your company. We want to help you gain control over your career and this new technology that has become such an important part of it.

Our seminars are designed to keep you up-to-date on all the latest developments and changes that occur in the world of data and PC technology. This two day seminar, **Telecommunications Technologies for the Non-Engineering Professional**, is presented in an easy-to-understand format and covers key elements, features, and benefits (see page 4) that I know will be valuable assets to you and your company. We'll explore the total spectrum of telecommunications, from its most basic concepts to its unlimited future potential (see page 3).

Our goal is to help you achieve the success that awaits you. We invite you to join the over 60,000 satisfied business professionals, from companies all over North America (see page 16), who have come and experienced - The Data-Tech Difference!

Best regards,

John L. Ignozza
President

JLI:jr

ABOUT THE SEMINAR

This seminar demystifies the fast-moving world of telecommunications for the non-engineering professional and presents it in an easy-to-understand format. We'll examine all the technologies of telecommunications and give you a better understanding of the industry. Learn how these technologies work together to form today's communications network.

This Seminar Has Been Developed to Enable Non-Engineers to:

- Understand all aspects of communications technologies and how to apply them to today's networks
- Contribute and direct tele/data communications related decisions
- Know how to incorporate the latest tele/data communications equipment and services into your current plan

WHO SHOULD ATTEND THIS SEMINAR

This seminar is extremely beneficial if you need a better understanding of the technologies that comprise telecommunications today. For non-technical professionals, a basic familiarity with telecommunications terms is necessary to gain maximum benefit from this seminar.

The following professionals will find this seminar an invaluable tool:

- DP Managers and Planners
- Information Center Managers
- Data Communications Managers and Technicians
- Telecommunications Managers and Technicians
- MIS Directors
- Marketing Representatives of Telcos, OCCs and Equipment Vendors
- Systems Analysts
- Anyone Involved in Telecommunications Planning

FOUR KEY ELEMENTS TO UNDERSTANDING TELECOMMUNICATIONS

Voice/Data Communications

You'll begin by learning the basic concepts of voice communications: how a telephone call is accomplished and the types of user equipment available. Then we'll examine how data communications work through the telephone network, the types of hardware available and industry standards.

Today's Communications Networks

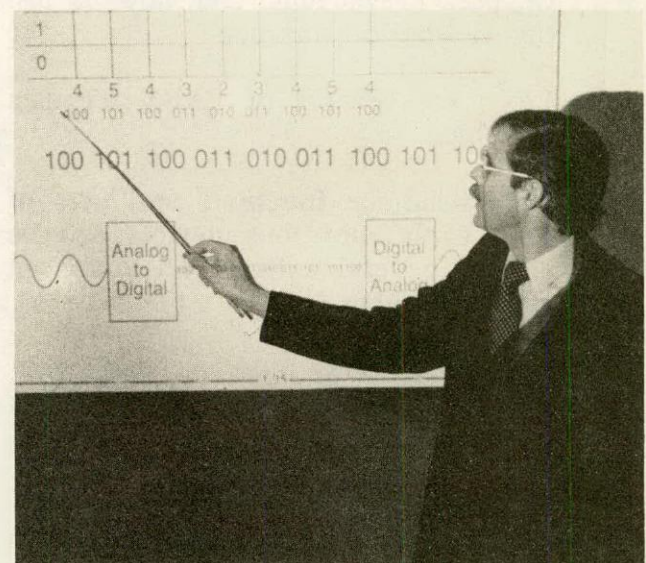
You'll examine in detail the technologies that make up today's communications networks including T1, X.25 and Local Area Networks. Learn the advantages and disadvantages of each technology and what to anticipate as new trends develop.

Exploring Transmission Technologies

We'll focus on the different types of transmission technology used to transport voice and data; such as, cables, satellite, fiber, etc. We'll then examine and compare the advantages, disadvantages, costs and applications of each media.

The Future of Telecommunications

Explore the intriguing future of telecommunications. Examine the impacts of ISDN on existing networks. Understand the strategies of both vendors and service providers in order to plan for the migration of ISDN.



20 KEY FEATURES & BENEFITS OF ATTENDANCE

1. Understand the overall telecommunications industry so that you may **make well-informed decisions** regarding your network
2. Examine the advantages and disadvantages of new telecommunications technologies and know how to apply them to your organization
3. Obtain action plans from your competitors who have used new telecommunications services to **increase productivity**
4. Learn what **T-1 Networking** is all about and the applications for its use
5. Explore the multitude of long distance services available today and how to select the one most appropriate to meet your business needs
6. Learn the many benefits of digital transmission as compared to analog
7. Find out who are the **major vendors and service providers** to the telecommunications industry
8. Learn the **benefits of a digital PBX** compared to an analog PBX
9. Explore the operations and applications of packet switching and how it can benefit your organization
10. Learn the benefits of **PABX** for data switching
11. Understand the **functions and uses of data communications devices** and be able to better interface with your data communications staff
12. Understand how modems and multiplexers operate and how to apply them to your network
13. Understand the path and process of a telephone call from the time you pick up the receiver until the distant party answers



14. Learn how to benefit from the various data communications configurations such as point-to-point and multi-point
15. Examine **fiber optics** transmission and learn how and where its applications are most effective
16. Explore other transmission alternatives — **satellite and microwave communications** and their potential applications
17. Learn how the cellular telephone works
18. Examine modern messaging systems, devices, services offered and costs — and learn how to apply them to maximize efficiency and productivity
19. Examine various **Local Area Networks** and configurations to determine which one best meets the needs of your organization
20. Explore the **advantages, uses and economics of ISDN** (Integrated Services Digital Network) and learn how to plan for your network's migration

COMPREHENSIVE SEMINAR OUTLINE

1. TELECOMMUNICATIONS UPDATE

"Telecommunications" is defined with a review of the four principal types.

- A. Voice
- B. Data
- C. Message
- D. Image

2. VOICE COMMUNICATIONS

The basic instrument of all communications technology is the telephone. We'll examine the various types of telephone equipment used in an office and the numerous services available.

- A. Voice Characteristics/Bandwidth
- B. The Telephone Instrument and its Basic Parts
- C. Central Offices
- D. The Telephone Line (Local Loop)
- E. Inter-office Trunks
- F. North America Numbering Plan (NPA)
- G. Local Exchange Services
 - 1. Intra-exchange
 - 2. Inter LATA
 - 3. Intra LATA
 - a. Flat rates
 - b. Measured service
 - 4. Types of service
 - a. Individual
 - b. Party-line
 - c. Extended area service
- H. Long Distance Services
 - 1. DDD
 - 2. Operator assisted
 - a. Person-to-person
 - b. Collect
 - c. Calling card
 - 3. WATS
 - a. Inbound
 - b. Outbound
 - 4. Foreign Exchange Service (FX)
 - 5. Tie-line

COMPREHENSIVE SEMINAR OUTLINE (cont'd)

- I. Digital vs. Analog Transmission**
- J. Key Systems**
 - 1. Electro-mechanical
 - 2. Electronic
 - 3. Features
- K. PABXs**
 - 1. Analog vs. digital
 - 2. Trunks: 2-way, DID, TIE, FX, WATS
 - 3. Features
 - 4. Data Switching

3. STANDARDS ORGANIZATIONS & THE ISO REFERENCE MODEL

We'll review the standards organizations which set the standards for voice and data communications. The International Standards Organization's (ISO) Open Systems Interconnect (OSI) Reference Model will be introduced and the associated buzz words will be discussed.

- A. Standards Organizations**
 - 1. ANSI
 - 2. EIA
 - 3. CCITT
 - 4. ISO
- B. The ISO Reference Model**
 - 1. The Seven Layers
 - 2. Peer Protocols
 - 3. The Intermediate Node
 - 4. Nested Protocol Data Units (PDUs)

4. DATA COMMUNICATIONS

Data communications systems are designed to transmit data from one location to another. We'll examine the hardware, controls and procedures used in data communications.

- A. System Components: Terminals, Medium and the Computer**
- B. Types of Terminals**
 - 1. Typewriter or keyboard
 - 2. Video
 - 3. Transaction
 - 4. Intelligent
 - 5. Specialized
- C. Modulation: Amplitude, Frequency Division and Pulse Code**
- D. Data Basics: Bits, Bytes and Baud**
- E. Coding Standards: ASCII and EBCDIC**
- F. Parity Checking**
- G. Protocols**

- H. Synchronous vs. Asynchronous Transmission
- I. Transmission Mode: Simplex, Half-duplex and Full-duplex
- J. Modems
- K. Multiplexers: Time Division and Statistical
- L. Line Configuration: Point-to-point and Multi-point

5. LOCAL AREA NETWORKS

In this section we'll examine the most widely used configurations in a Local Area Network; the two basic transmission techniques, the various physical paths over which transmission takes place and the methods for a device to access the Local Area Network.

- A. Network Topology
 - 1. Star
 - 2. Bus
 - 3. Ring
 - 4. Tree
- B. Baseband vs. Broadband
- C. Access Methods
 - 1. CSMA/CD
 - 2. Token passing
- D. Repeaters, Bridges and Gateways
- E. Performance

6. X.25/PACKET SWITCHING

We'll examine the X.25 protocol; what a packet consists of; how the packet passes from node to node within the packet switching network and how a message is sliced into packets by a Packet Assembler/Disassembler.

- A. Packet Switching Networks
- B. The History of X.25
- C. Virtual Circuits
- D. Packet Assembler/Disassembler (PAD)
- E. How it All Works
- F. Network Considerations
 - 1. Existing facilities
 - 2. Traffic statistics
- G. Topology Design Considerations
 - 1. Physical considerations
 - 2. Cost considerations
 - 3. Requirements of the network

COMPREHENSIVE SEMINAR OUTLINE (cont'd)

7. T-1 NETWORKING

We'll explore T-1 technology and examine the various methods used to convert analog voice signals into digital bit streams. We'll examine the different signal levels, their corresponding digital bit rate, equivalent voice circuits, carrier system and their typical medium of transmission. The role of the T-1 multiplexers will be explained and case examples given.

- A. T-1 Basic Understanding
- B. T-1 Characteristics
 - 1. Digital transmission
 - 2. Full duplex mode
 - 3. Voice digitization methods
 - a. Pulse Code Modulation (PCM)
 - b. Adaptive Pulse Code Modulation (ADPCM)
 - c. Continuously Variable Slope Delta Modulation (CVSDM)
 - 4. 1.544Mbs rate
- C. North American Digital Hierarchy DS-0, DS-1, DS1-C, DS-2, DS-3, DS-4
- D. T-1 Multiplexers
- E. T-1 Digital PABX Connectivity
- F. T-1 Transmission Media
- G. T-1 Advantages

8. TRANSMISSION VIA CABLES

Transmission takes place over a variety of media. We'll examine the various cable media used in transmission and their technological differences. Learn about the different physical characteristics, technical advantages and disadvantages, costs, placement requirements and applications of each cable media.

9. TRANSMISSION VIA SATELLITE

We'll investigate the concepts and potential applications of satellite channels. Explore the actual path of transmission to and from different earth stations.

- A. Earth Station
- B. Satellite Location; Geosynchronous Orbit
- C. Transponders
- D. Advantages
- E. Disadvantages
- F. Applications

10. TRANSMISSION VIA MICROWAVE

We'll examine the equipment required in a microwave system, the advantage of digital microwave over analog systems, the principal advantages and disadvantages and the frequency allocation.

- A. Equipment: Tower, Antenna, Radio and Repeaters
- B. Digital vs. Analog
- C. Frequency Impairments
- D. Microwave Impairments
- E. Principal Advantages
- F. Short-haul Microwave
 - 1. Frequency allocation
 - 2. Applications
 - Telco bypass

11. MESSAGE SYSTEMS

Although the telephone is the most efficient, fastest and often the least expensive method of communicating, there are other alternatives. We'll examine electronic mail, facsimile systems and teletypewriters and learn their operations and applications.

- A. Electronic Mail
 - 1. Benefits
 - 2. Additional services
- B. Facsimile Systems
 - 1. Advantages
 - 2. Features and drawbacks
- C. Teletypewriter Services
 - 1. Telex
 - 2. TWX

12. CELLULAR RADIO

We'll examine the cellular network, the various pieces of equipment required, the frequencies involved and how calls are processed and billed from various locations.

- A. Cell Site
- B. Mobile Telephone Switching Office (MTSO)
 - 1. Wireline vs. non-wireline
 - 2. LEC network
- C. Cellular Frequencies
- D. Numeric Assignment Module (NAM)

COMPREHENSIVE SEMINAR OUTLINE (cont'd)

- E. Roaming
 - 1. Outgoing calls
 - 2. Incoming calls
- F. Billing

13. INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

One of the most important major changes in telecommunications is the Integrated Services Digital Network (ISDN). We'll examine what ISDN is, what services it will provide and how it will impact existing networks. Methods of accessing the ISDN network and how the signaling is accomplished will be discussed.

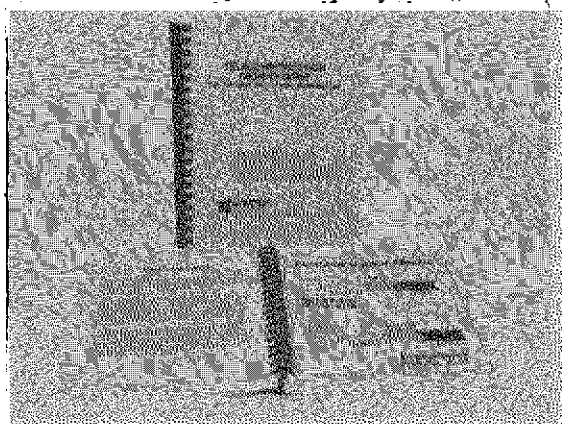
- A. Services Provided by ISDN
- B. Access Modes
 - 1. Primary rate interface
 - 2. Basic rate interface
- C. Signaling
- D. Numbering Plans
- E. Connectors
- F. Benefits of ISDN

STILL UNDECIDED?

Give us a call! We will supply you with names and phone numbers of previous attendees who have agreed to let us use them as a reference. They can attest to the high quality and useful, practical information they received at this seminar. Call 1-201-478-5400.

COURSE MATERIALS

You will receive a complete, detailed workbook filled with information including examples of various technologies and how they work—individually and integrated. Also included is a comprehensive set of lecture notes with clear definitions and diagrams. This is a complete reference manual.



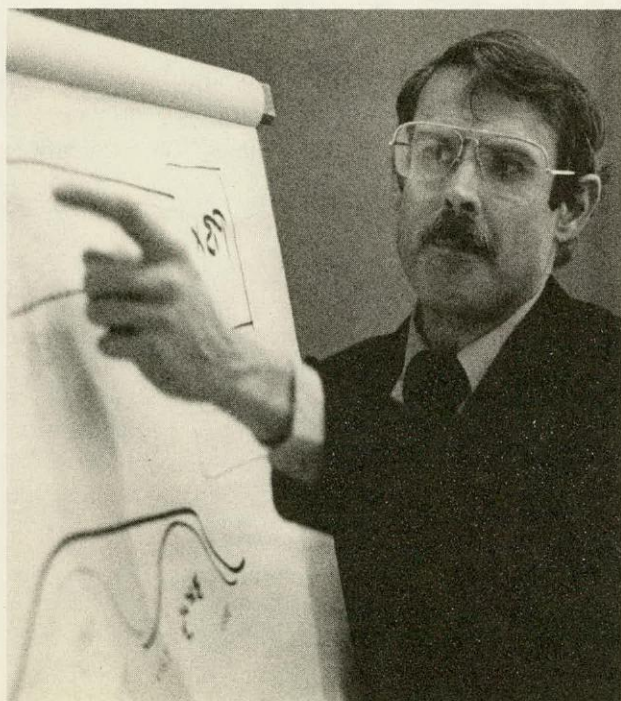
Featured is an Invaluable Glossary of Common Industry Acronyms

ABOUT THE COURSE DIRECTOR

Tim Kelly has been actively involved in the data/telecommunications field for over 18 years. He was involved in early modem application development at Collins Radio and ran some of the first synchronous modem tests over DDD and WATS facilities. He designed protocol interfaces for store and forward message switching systems at Control Data Corp. At GTE he was product manager for a 270X front-end emulator for the IBM 360/370 series machines. This required the development of protocols for both IBM and non-IBM devices. His time at TRW was spent in point-of-sale related product development from terminals to data collection devices—one of which used a variation of BSC through asynchronous modems.

Mr. Kelly is currently employed at Logicon, a high technology company which produces real-time simulators and training systems for government and industry. He designs the communications systems for geographically distributed real-time testbeds and simulators. These systems have used facilities from analog to T-1 carrier systems.

In addition, Mr. Kelly has frequently taught seminars nationally on subjects from data and telecommunications through network protocols to higher levels of protocol.



ABOUT THE COURSE LEADER

Regis J. (Bud) Bates has over 23 years experience in telecommunications and management information systems, with specific expertise in end user management, systems integration, strategic planning and technical training. He has been directly responsible for the design, implementation and management of numerous telecommunications systems (ranging in size from 200-8000 lines) and networks (T1, ETN/ESN, etc.), local area networks, wide area networks, network management systems, data processing centers and totally integrated information networks. He has managed operations with budgets in excess of \$20 million annually and staffs with over 25 professionals. His efforts have saved companies an average of **\$2-4 million** annually in telecommunications and information systems expenditures.

Mr. Bates develops and teaches both public and in-house professional seminars in telecommunications, networking, computer systems integration, and regularly contributes his expertise in research and technical publishing activities. He holds a degree in Business Management (Magna Cum Laude) from Stonehill College, Easton, MA and has completed graduate level courses at Lehigh University and Saint Joseph's University.

ABOUT DATA-TECH INSTITUTE

Continuing a quality professional education is a need met by Data-Tech Institute—a leader in the presentation of one and two day seminars/workshops. The Data-Tech proven curriculum, taught by highly qualified technical experts in their field, responds to rapid changes in technology. Many of our programs are equipment-based—offering tips, tricks and techniques that can make a real difference in your career. Data-Tech is set apart by live in-class training featuring hands-on demonstrations, comprehensive course materials, free software and a track record substantiated by hundreds of Fortune 1000 corporations, as well as small to medium-sized corporations who have attended our seminars. Through our specialized training, we're actively solving problems facing today's business professional in the working environment.

WHAT PEOPLE ARE SAYING ABOUT...

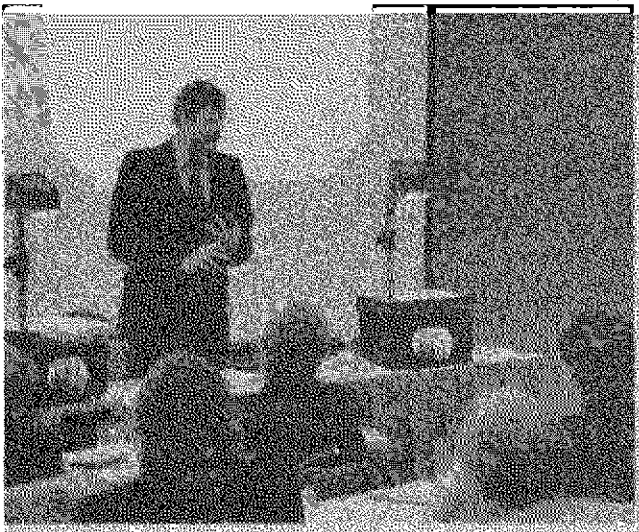
The Seminar

"This course definitely would have made my job easier years ago!"

Ray Sheridan
Computer Specialist
GSA

"This was an extremely good introduction course — materials were very helpful and comprehensive."

Larry Blau
Computer Associate
City of New York



"This seminar was excellent! It really exceeded my expectations."

Dave Hill
Systems Analyst
C.I.T.C.

"This seminar was very beneficial— it provided me with an understanding of the technologies that I deal with daily."

Betty High
Director of Communications
Harborview Medical Center

The Instructor

"Tim did a great job of converting complicated concepts to a more understandable form and gave excellent examples."

Ron Guth
Manager, Engineering Services
United Telephone Northwest

"Tim Kelly had a good grasp of the subject and was able to relate theory to real-world applications."

David Stohl
Curriculum Manager
Texas Instruments

"Tim Kelly was outstanding! He stimulated a lot of thoughts regarding applications and future direction this industry may take."

Richard Duffy
Assistant Manager
New Jersey Bell

"Excellent! The instructor's superb teaching skills and the logical flow of information ensure understanding."

John Crowley, Jr.
Senior Product Line Manager
ITT Defense Communications

"Instructor demonstrated excellent teaching skills and genuine enthusiasm. I was impressed with both his knowledge of telecommunications and his ability to answer all questions."

John Ransom
MIS Director
White Castle Systems, Inc.

PRIVATE ON-SITE PRESENTATIONS

Take advantage of Data-Tech's customized on-site training, featuring all the benefits of our public seminars taught in the location of your choosing.

Save Time and Tuition

When ten or more employees from the same company choose to attend a Data-Tech seminar, it is cost-effective to bring the seminar on-site. Your company will save money on travel costs and accommodations — and eliminate the amount of wasted time spent away from the office.

Customize Training

Discuss the course content with the course director beforehand, indicating your company's wants, needs and expectations. The course director is then better prepared to address the specific issues that interest you and your company. You will be provided with the most up-to-date and pertinent information available.

Maintain Confidentiality

On-site seminars allow our course directors to address your company and attendees individually. You will get practical solutions to your problems, plus tips to improve productivity and increase performance. Most importantly, your problems and the solutions to those problems will be kept "in-house."

Receive Quality Instruction

All Data-Tech seminars can be brought on-site and are taught by our highly qualified team of instructors. Chosen for their expertise in particular fields of interest and their extensive teaching experience, they consistently score high ratings for making complex subjects easy to understand. All of Data-Tech's seminars include comprehensive course materials that are yours to keep once the seminar is over.

Bring quality Data-Tech Institute seminars on-site. The advantages are enormous. For more information about scheduling an on-site seminar, call our On-site Training Department at 1-201-478-5400.

PARTIAL LISTING OF ON-SITE COURSES:

DATA COMMUNICATIONS AND NETWORKING SEMINARS

- Understanding Data Communications: A Practical Guide
- Local Area Networks: Including IBM's Token Ring Network, Network General's Sniffer and Novell's Netware
- Networking Personal Computers: IBM PCs, PS/2s & Apple Macintoshes
- Troubleshooting & Maintaining a Local Area Network
- Taking Control of Your Novell NetWare
- Troubleshooting Novell NetWare

TELECOMMUNICATIONS SEMINARS

- Telecommunications Technologies For the Non-Engineering Professional
- An Intensive Introduction to T1/T3 Networking
- An Intensive Introduction to ISDN
- ESF: Implementing High Performance Diagnostics on a T1 Network
- Disaster Recovery & Restoration For Telecommunications Facilities & Networks

MICROCOMPUTER SEMINARS

- The IBM PC Survival Course
- Troubleshooting & Maintaining the IBM PC, XT, AT, PS/2 & Compatibles
- Installing, Maintaining & Troubleshooting Disk Drives, Printers & Modems
- OS/2 Essentials: Clear Answers to Tough Questions
- How to Support Microcomputer Users Effectively
- Setting Up & Managing a Computer Help Desk

BUSINESS APPLICATIONS USING LOTUS 1-2-3 SEMINARS

- Becoming a Lotus Power User in Finance & Accounting
- Budgeting & Forecasting Using Lotus 1-2-3
- Marketing, Sales Analysis & Forecasting Using Lotus 1-2-3

ADDITIONAL SEMINARS

- Building a Computer-based Sales & Marketing Information/Support System
- Evaluating & Comparing CASE Tools
- "How to" Telemarketing Techniques
- Improving the Software Testing Process
- Negotiating Software License Agreements
- Software Licensing Agreements: Buying, Selling & Protecting Rights
- Understanding & Analyzing Financial Statements For Non-Financial Professionals
- Understanding SQL Databases & Client/Servers

SEMINAR INFORMATION

LOCATION: This seminar will be held on the following dates in the following locations:

SAN FRANCISCO, CA
JANUARY 3-4, 1991
Hyatt Oakland
455 Hegenberger Road
Oakland, CA 94621
(415) 562-6100

COLUMBUS, OH
JANUARY 14-15, 1991
Hyatt Regency Columbus
350 North High Street
Columbus, OH 43215
(614) 463-1234

MINNEAPOLIS, MN
JANUARY 16-17, 1991
Holiday Inn Minneapolis West
9970 Wayzata Boulevard
St. Louis Park, MN 55426
(612) 593-1918

NEW YORK, NY
JANUARY 28-29, 1991
Novotel New York
226 W. 52nd Street
New York, NY 10019
(212) 315-0100

WASHINGTON, DC
JANUARY 30-31, 1991
Holiday Inn Capitol
550 C Street SW
Washington, DC 20024
(202) 479-4000

BOSTON, MA
FEBRUARY 5-6, 1991
The 57 Park Plaza Hotel
200 Stuart Street
Boston, MA 02116
(617) 482-1800

DETROIT, MI
FEBRUARY 7-8, 1991
Dearborn Inn
20301 Oakwood Boulevard
Dearborn, MI 48124
(313) 271-2700

DENVER, CO
FEBRUARY 19-20, 1991
Executive Tower Inn
& Conference Center
1405 Curtis Street
Denver, CO 80202
(303) 571-0300

SEATTLE, WA
FEBRUARY 21-22, 1991
Holiday Inn—Sea Tac
17338 Pacific Highway South
Seattle, WA 98188
(206) 248-1000

This seminar is also scheduled as follows. Please call 1-201-478-5400 for hotel information.

Morristown, NJ	—	November 12-13, 1990
San Antonio, TX	—	November 14-15, 1990
St. Louis, MO	—	November 19-20, 1990
Orlando, FL	—	November 27-28, 1990
Atlanta, GA	—	November 29-30, 1990
Philadelphia, PA	—	December 10-11, 1990
Oklahoma City, OK	—	December 12-13, 1990

GUARANTEE:

Data-Tech Institute offers the best training available in this field. If you are not satisfied, please notify the instructor before the end of the first day. Should you decide to withdraw, you will receive a credit of your payment towards any other Data-Tech Institute seminar or a refund of the seminar fee.

COURSE FEE:

The full registration fee of \$695.00 per attendee is payable in advance and includes the cost of the seminar/workshop, workbook and all meeting materials.

CANCELLATION CONSIDERATION:

If you are unable to attend the seminar, please let us know immediately so that we may open your reserved space to another attendee. In the unlikely event that Data-Tech must cancel a class, Data-Tech's liability is limited to the course fee. Data-Tech is not liable for any travel or lodging expense. Data-Tech Institute will use best efforts to notify registrants of any cancellations as early as possible.

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Architecture 139 X

Computers for Skeptics

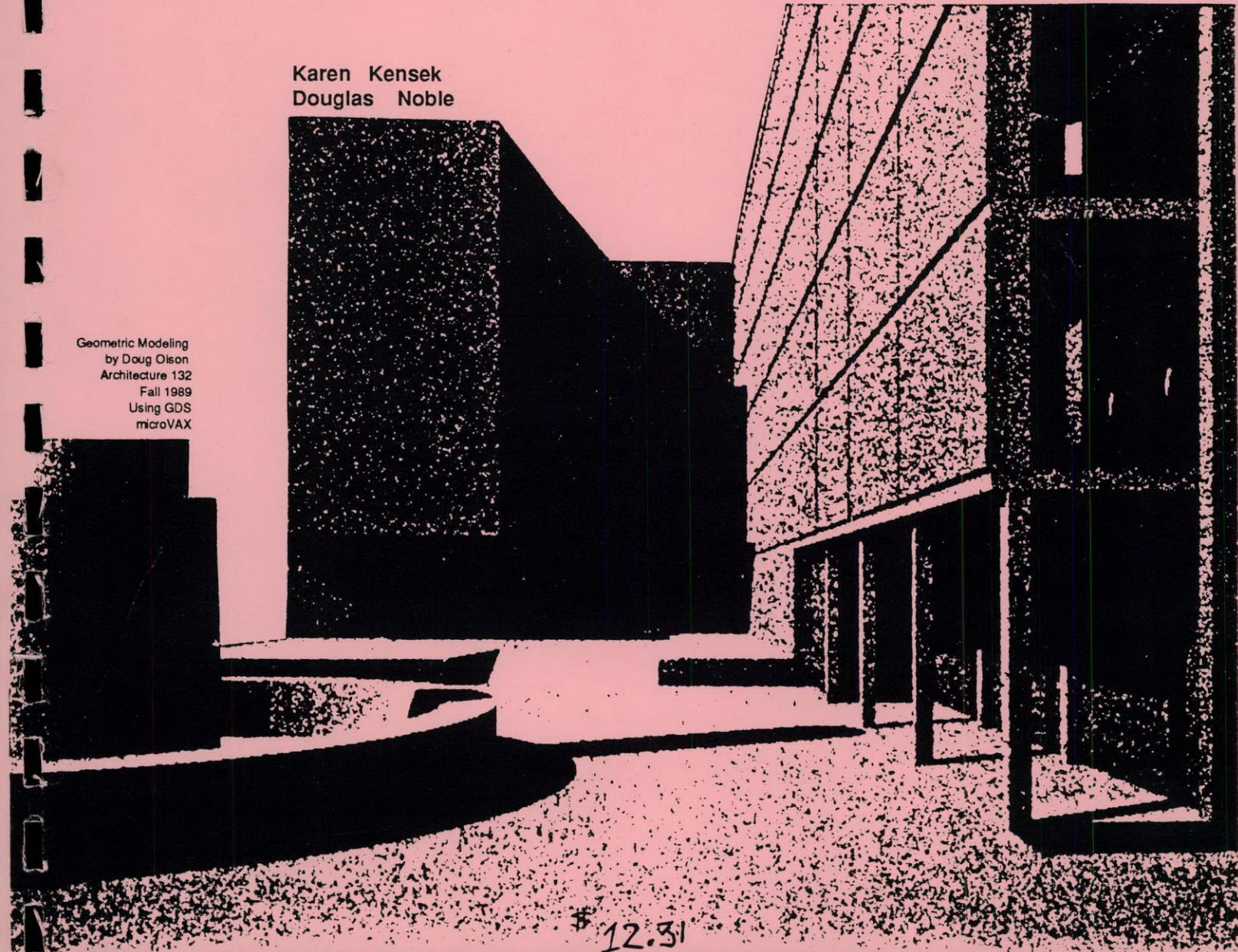
Fall 1990

Department of Architecture
College of Environmental Design
University of California, Berkeley

Karen Kensek
Douglas Noble

Geometric Modeling
by Doug Olson
Architecture 132
Fall 1989
Using GDS
microVAX

\$ 12.31



Architecture 139 X (Section 2)

Fall 1990

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Syllabus

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| Reading 2 | Hard and Soft Choices |
| Reading 3 | The Electronic Workspace |
| Reading 4 | Solid Modeling and Volumetric Composition in Architecture |
| Reading 5 | Hyper-Reality: Assorted Newspaper Articles |
| Reading 6 | TABLET: Personal Computer in the Year 2000 |

IBM Reference

- | | |
|---------------|---|
| Reference 1.0 | DOS Fundamentals |
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Course Description

Summary:

Course:	Arch 139X (2), 1 unit
Title:	Computers for Skeptics, Cynics, and Cyberphobes
Semester Offered:	Fall 1990, October 1 - October 29
Class Meetings:	Monday's 6-9 PM
Instructors:	Douglas Noble, 482 Wurster Hall Karen Kensek, 471 Wurster Hall
Prerequisite:	Intended for students with little or no computer background
Final Examination:	None
Grading option:	P/NP or S/U only
Evaluation:	Based on class participation & attendance and "term" paper. Paper 75% Attendance 25%

Introduction and Objectives:

The purpose of this class is to introduce the use of computers in the field of architecture to those who may be skeptical. The course will require only limited contact with the actual machines for homework assignments and will instead focus on demonstrating a wide range of applications in architecture through a weekly lecture series and group hands-on workshops on different application programs.

Student Assignment:

To pass this course you must complete one paper on a subject within the broad heading of "Computer Applications in Architecture." We will be discussing and assigning paper topics at the first class meeting.

- 1) A rough draft of the paper, printed on the laser printer, is due **October 15th** at the beginning of class.
- 2) The paper should be 10-12 pages, one and a half line spacing (between single and double spaced)
- 3) Include 1" margins all the way around, and use 12 point Times-Roman.
- 4) You must include at least three graphic images, which do not count as part of the 10-12 pages
- 5) Be certain to include a title sheet with your name, date, title of paper, etc.
- 6) The paper will be graded based on content, structure, and grammar.
- 7) **The final paper is due October 29th.** You must also turn in a disk with the paper on it.

Course Materials:

You will need the following materials:

- 1) card key for access to 330 (\$20 lab fee plus \$10 refundable deposit)
- 2) a class reader / reference manual; do the assigned readings **before** lecture!
- 3) at least two double sided double density (DSDD) 5 1/4" IBM compatible disks (about \$1.00 each)

Department of Architecture
College of Environmental Design
University of California, Berkeley

Architecture 139X (2)
Fall 1990
Syllabus

Syllabus

Week 6 (October 1)

Lecture: Introduction and Personal Computer Hardware

Section: Computer Resources in the College of Environmental Design

Week 7 (October 8)

Lecture: System and Application Software

Section: DOS, Microsoft Word, and Networking

Readings 1, 2

Week 8 (October 15)

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Paper due

Reading 1

Running MS-DOS

Van Wolferton

Running MS-DOS
1989

CHAPTER

1

WHAT IS DOS?



You've got your computer and you've probably got one or two programs, such as a word processor or a spreadsheet, to use with it. But what is this thing called DOS? Why do you hear so much about it, and why have hundreds of pages of instructions been written for it?

DOS IS A PROGRAM

DOS is a program, but it's not just any program. Chances are none of your other programs would work without it, because DOS controls every part of the computer system. DOS not only makes it possible for your other programs to work, it also gives you complete control over what your computer does, and how. DOS is the link between you and your computer.

To appreciate the role DOS plays, take a quick look at the pieces of your computer system and what they do.

HARDWARE MAKES IT POSSIBLE

Your computer equipment, called *hardware*, probably includes a keyboard, display, printer, and one or more disk drives. The purposes of the first three are straightforward: You type instructions at the keyboard, and the system responds by displaying or printing messages and results.

The purpose of a disk drive isn't quite so obvious, but it quickly becomes apparent as you use the system: A disk drive records and plays back information, much as a tape deck records and plays back music. The computer's information is recorded in files on disks; you'll find that disk files are as central to your computer work as paper files are to more traditional office work.

SOFTWARE MAKES IT HAPPEN

No matter how powerful the hardware, a computer can't do anything without programs, called *software*. There are two major types of software: *system programs*, which control the operation of the computer system, and *application programs*, which perform more obviously useful tasks, such as word processing.

Each program uses the hardware. It must be able to receive instructions from the keyboard, display and print results, read and write files from and to a disk, send and receive data through the computer's communications connection, change the colors on a color display, and so on through all the capabilities of the hardware.

So that each program doesn't have to perform all these functions for itself, a system program called the *operating system* manages the hardware. The operating system allows an application program to concentrate on what it does best, whether it's moving paragraphs about, tracking accounts receivable, or calculating stress in a bridge beam. DOS is an operating system.



DOS IS A DISK OPERATING SYSTEM

The operating system for many computers, including the IBM personal computers, is the Disk Operating System from Microsoft. It is called a disk operating system because much of its work involves managing disks and disk files.

What Does an Operating System Do?

An operating system plays a role something like a symphony conductor. When the score calls for the violins to play, the conductor cues the violins; when the score says the cellos should play more softly, the tympani should stop, or the entire orchestra should pick up the tempo, the conductor so instructs the musicians.

The players in the orchestra and their instruments represent the hardware. The experience and skill of the conductor represent the operating system. The score represents an application program.

When one score is replaced by another—Vivaldi's *Mandolin Concerto* is put aside and replaced by Haydn's *Surprise Symphony*, for example—the same musicians use the same instruments, and the same conductor uses the same experience and skills. A different sound, a different mood, perhaps, but the elements are the same.

When one application program is replaced by another—for example, an accounting program is put aside and replaced with a word processor—the same hardware carries out the instructions of the same operating system. A different program, a different purpose, perhaps, but the elements are the same.

DOS coordinates the computer system, just as the conductor coordinates the orchestra. Your application programs run in concert with DOS, trusting it to keep the system humming.

Much of what DOS does, such as how it stores a file on a disk or prints on the printer, is invisible to you. But DOS lets you control the things you care about, such as which program to run, what report to print, or what files to erase. These functions share an important characteristic: They need disks and disk drives.

Disk Drives

Personal computers use two main types of disk: a flexible disk in a protective plastic jacket, called a *diskette*, which you can remove from the drive, and a permanently mounted unit called a *fixed disk*. There are two types of diskette: 5.25 inches square in a flexible plastic jacket, and 3.5 inches square in a rigid plastic shell.

A fixed disk holds much more information than a diskette—from 15 to 100 times as much, or even more—and is much faster. Most personal computers have either one fixed disk and one diskette drive, or two diskette drives.

To distinguish among the types of disk, this book uses *diskette* to mean either type of flexible disk, *fixed disk* to mean only a fixed disk, and *disk* to refer to both.

Disk Files

Just as you organize and store your written records in paper files, you organize and store computer information in disk files.

A disk file—usually called a file—is a collection of related information stored on a disk. It could be a letter, an income tax return, or a list of customers. It could also be a program, because the programs you use are stored in files.

Virtually all your computer work revolves around files. Because one of the major functions of DOS is to take care of files, much of this book is devoted to showing you how to create, print, copy, and otherwise manage files. As you go through the practice sessions in the following chapters, you'll notice references to some versions of DOS that have more file-handling abilities than other versions.

Different Versions of DOS

DOS has been revised a number of times since its release in 1981: the first version was numbered 1.00. DOS is revised to add more capability, to take advantage of more sophisticated hardware, and to correct errors. When you start up your system, DOS may display the version number that you are using.

When a new version of DOS appears, a change in the number following the decimal point—3.20 to 3.30, for example—marks a minor change that leaves DOS substantially the same as the previous version. A change in the number preceding the decimal point marks a major change. Version 2.00, for example, offered almost three times as many commands as version 1.10.

This book covers all versions of DOS. Even though newer versions have much more capability, they remain compatible with earlier versions. Thus, if you start with version 2.1, you can still use all your knowledge and experience, plus all your files and diskettes, when you move to a newer version.

For simplicity, this book usually refers to DOS by major version numbers only: for example, version 3 or version 4, rather than version 3.1 or version 4.00. It also omits references to versions of DOS earlier than version 3, but much of the information applies to these versions too. Remember, version 2 is just as much a part of DOS as version 4. It's simply older and, though it includes most of the features described here, it doesn't provide them all.

What Is Compatibility?

You may have seen the terms DOS-compatible or IBM-compatible used in an article or advertisement. What does compatible mean? Although some technical issues are involved, the most meaningful measure of compatibility is the extent to which you can use the diskettes from one system in another:



- If two systems are totally compatible, you can freely exchange diskettes. This situation is common among IBM-compatible computers.
- If two systems are incompatible, you cannot exchange diskettes because neither system can read files stored by the other. That's why you can't use a diskette from an Apple computer in an IBM Personal Computer.
- If two systems are partially compatible, you can interchange some diskettes, particularly those that contain files of information rather than programs.

This last level, of partial compatibility, is what is usually meant by the term MS-DOS-compatible and is one of the advantages of using an operating system that runs on so many different machines.

To maintain consistency, this book describes how DOS works on the IBM PS/2 (all models), IBM PC/AT, IBM PC/XT, and IBM PC. If your computer is a compatible machine, however, the descriptions apply equally to your system.

WHAT CAN YOU DO WITH DOS?

DOS coordinates the operation of the computer for your application programs. That's valuable—essential, really—but DOS has much more to offer. You can use DOS, controlling it with instructions called *commands*, to manage your files, control the work flow, and perform useful tasks that might otherwise require additional software.

For example, DOS includes a program called Edlin that lets you create and revise files of text. Although it's not a word processor, Edlin is fine for short memos and lists. Using Edlin, you can write short documents in less time than it might take to start your word-processing program and store the file.

You can tailor DOS to your specific needs by creating powerful commands made up of other DOS commands, and you can even create your own small applications. For example, this book shows you how to create a simple file manager—a program that lets you search a file for specific information—using nothing but DOS commands.

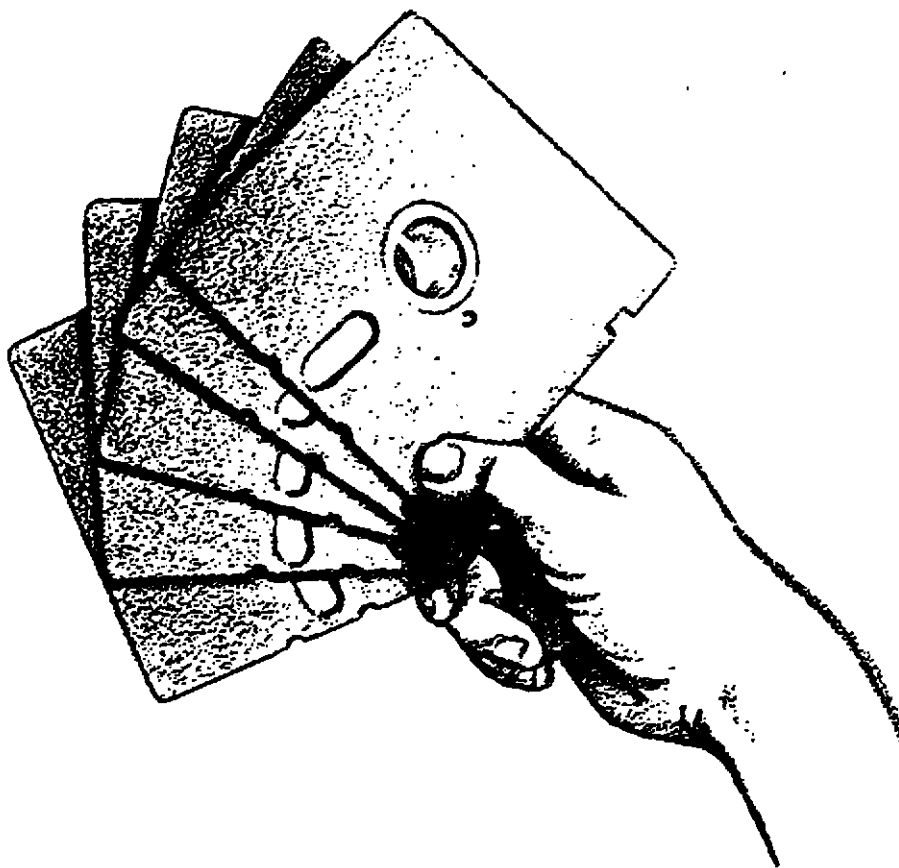
Beginning with version 4, DOS also includes a separate program, called the *Shell*, that lets you choose commands and files from on-screen lists called *menus*. If you want, you can use the Shell for routine work, or you can dispense with it and work directly with DOS by typing commands.

Your knowledge of DOS can range from just enough to use a single application program to mastery of the full range of capabilities in the later versions. But no matter how far you go, you needn't learn to program. It's all DOS, and it's all in this book.

CHAPTER

6

MANAGING YOUR
DISKETTES



HANDLING DISKETTES

Diskettes are remarkably durable, especially the 3.5-inch type in a hard plastic shell. The useful life of diskettes depends on how often you use them, of course, but even more important is how you treat them. Handle your diskettes with the same care you use when handling valuable recording tapes or photographs:

- Avoid touching the diskette surfaces that show through the openings in the protective jacket. Dirt, fingerprints, or dust can shorten the life of a diskette and can damage or destroy the data.
- Keep diskettes away from magnets and other sources of magnetic influence, such as telephones, electric motors, and television sets.

- 
- Keep food and drinks away from diskettes. The same goes for cigarettes, cigars, pipes, and ashtrays.
 - Don't fold, spindle, or mutilate diskettes. Don't pile other objects on them.
 - Don't write on diskette labels with a pencil, ballpoint pen, or other sharp instrument; use a felt-tipped marker.
 - Store your diskettes in a safe place when you're not using them. Protect them from extreme heat or cold, humidity, or contact with other objects.

Many products are available for storing diskettes, including plastic boxes, vinyl pockets that fit a three-ring binder, and hanging file folders. All offer good protection; they aren't necessary, but they make it easier for you to organize your diskettes and store them safely, rather than leaving them scattered around your desk.

Although an office is a mild environment compared to a factory or a shop floor, data on a diskette can be damaged by such innocuous objects as a paper clip that has been stored in a magnetic paper-clip holder, a magnetized letter opener, an electric pencil sharpener, or a telephone-answering machine. If you put a letter down on top of a diskette lying on your desk, it's all too easy to put a hot coffee cup or heavy object on the letter without realizing that the diskette is underneath.

The safest places for a diskette are in the computer and in protective storage. Information and time are two of your most valuable assets: A damaged diskette can cost you both, so protect your diskettes accordingly.

BACK UP YOUR DISKETTES

Even though you treat your diskettes with care, they can still be mislaid or damaged by accident. Files can be inadvertently changed or erased, and eventually diskettes simply wear out. Making backup copies of your diskettes limits the amount of information and time you lose if something goes wrong. The time it takes to make these copies could be one of your better investments.

Unless a program diskette is copy protected so that you cannot duplicate the original, make a copy of the program before you ever use it—even if you plan to install the program on your fixed disk. Store the original diskette in a safe place, and use the copy. If something happens to the copy, make another copy from the original. Always keep the original stored safely.

Your collection of data files will grow as you use application programs, such as a word processor or spreadsheet. Back up a data diskette whenever the value of the information it contains—or the time it would take to re-create it—is greater than the value of a blank diskette and the few minutes it takes to make a copy. Keep your backup copies in a safe place and use your computer with the comforting thought that, should something unforeseen happen, you're protected.

HOW INFORMATION IS STORED ON A DISKETTE

Information is stored on a diskette much as music or video is recorded on tape. A description of how DOS uses a diskette helps you understand the commands you use to manage your diskettes.

What Is a Diskette?

What we call a diskette actually consists of two parts: a disk of thin plastic coated with magnetic material, and a protective plastic jacket or hard shell. Figure 6-1 shows a 5.25-inch diskette in its flexible jacket, and Figure 6-2 shows both the front and back of a 3.5-inch diskette in its hard shell.

The dashed lines in Figures 6-1 and 6-2 show how the coated disk lies inside the protective jacket. The magnetic coating itself is visible through the openings in the jacket of a 5.25-inch diskette (shaded in Figure 6-1). The spring-loaded shutter that normally covers the opening in a 3.5-inch diskette is moved aside by the diskette drive to provide access to the magnetic coating. The hole in the center of the disk goes around the drive motor, which spins the disk so that data can be written (recorded) or read (played back).

The write-protect notch or slide lets you protect all the files on a diskette from being erased or changed. To protect a 5.25-inch diskette, cover the write-protect notch

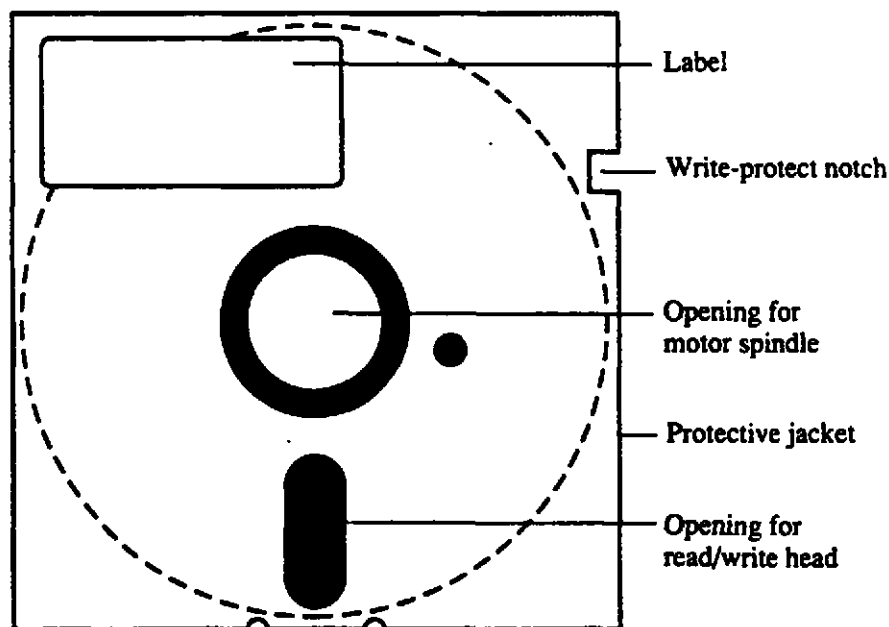


Figure 6-1. A 5.25-inch diskette

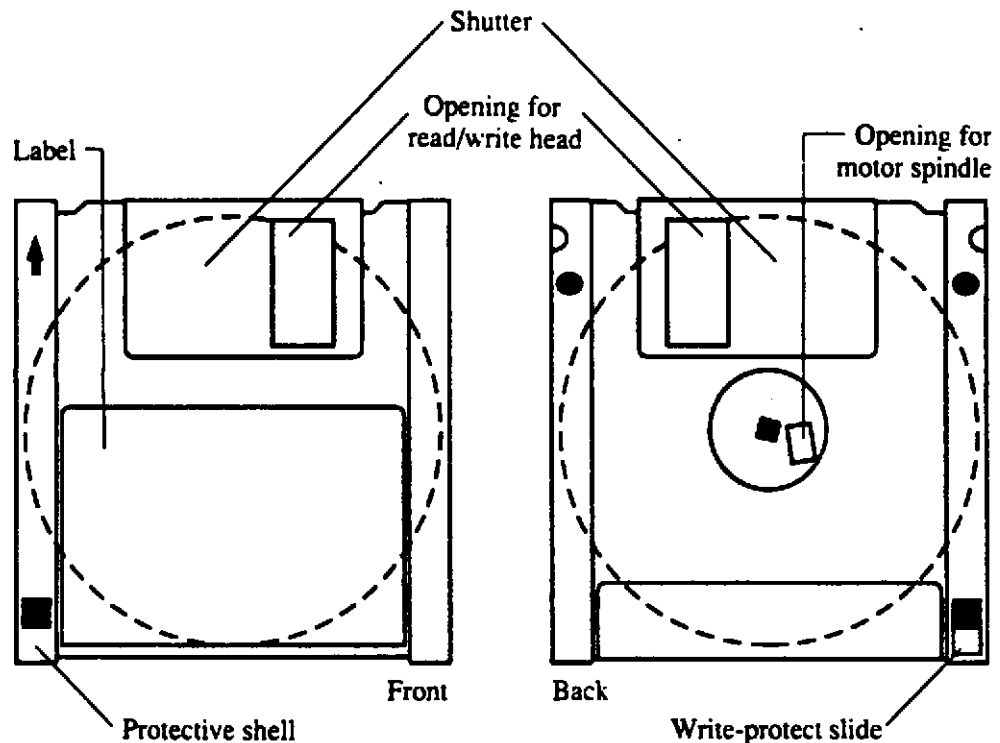


Figure 6-2. A 3.5-inch diskette

with one of the small tabs of tape included with the box of diskettes. To protect a 3.5-inch diskette, move the write-protect slide down (toward the edge of the diskette) until the hole through the diskette shell is open. To permit files on the diskette to be changed or erased, remove the tape or move the slide up until the hole is closed. Protect your DOS diskettes in this way; protect each of your application program diskettes, too, unless the application program manual tells you otherwise.

How Does DOS Keep Track of Files?

Information is recorded on a diskette in narrow concentric circles called *tracks*; there are 40 such tracks on a standard 360-kilobyte (360 K) diskette and 80 tracks on the high-capacity 5.25-inch and 3.5-inch diskettes used on the IBM PC/AT, IBM PC Convertible, IBM PS/2 models, and compatible systems. A track is divided into smaller areas called *sectors*, each of which can hold 512 bytes. Figure 6-3 on the following page shows how tracks and sectors are laid out on a diskette. For simplicity, the illustration shows only four tracks.

The side, track, and sector numbers of the beginning of a file are stored as part of the directory entry for the file. You don't see this information when you use the Directory command, but DOS can find any sector on a diskette by its side, track, and sector numbers, just as you can find any seat in a stadium or a theater by its section, row, and seat numbers.

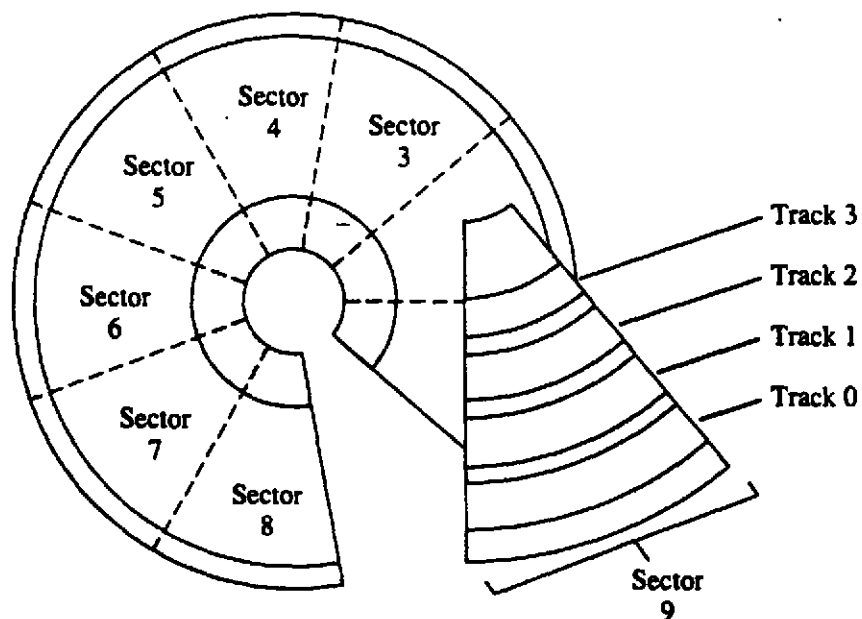


Figure 6-3. Tracks and sectors on a diskette

Diskette Capacity

Tracks on a standard diskette are numbered 0 through 39 (making 40 in all); sectors are numbered 1 through 9, for a total of 360 sectors (40 tracks times 9 sectors per track) on each side. Most personal computers that run DOS have double-sided drives, which use both sides of a diskette, but some earlier models had single-sided drives that used only one side. A standard double-sided (or 360 K) diskette has an actual capacity of 368,640 bytes (though not all of it is available for files); a single-sided (or 180 K) diskette has a capacity of 184,320 bytes.

The high-capacity 5.25-inch diskettes used on the IBM PC/AT and compatible systems have 80 tracks (numbered 0 through 79), each of which has 15 sectors. A sector still stores 512 bytes, so the two sides of a high-capacity (or 1.2 MB) diskette can hold 1,228,800 bytes.

The 3.5-inch diskettes used on the IBM PS/2 computers and compatible systems are also double-sided diskettes with 80 tracks per side. Depending on disk capacity, however, they have either 9 or 18 sectors per track—again with 512 bytes per sector. The 9-sectored (or 720 K) diskettes can hold 737,280 bytes; the 18-sectored (or 1.44 MB) diskettes can hold 1,474,560 bytes.

Volume Label

Any disk can be assigned a name, or *volume label*, to identify its contents. The volume label can be up to 11 characters long, and you can use the same characters allowed in a file name, plus a space. You can assign a volume label when you format a disk or at



any time later on. DOS stores the volume label on the disk and displays it when you use the Directory, Check Disk, Label, or Volume commands. The volume label is for identification only; you can't use it in a command to specify a disk.

PREPARING FOR THE EXAMPLES

The examples in this chapter require one diskette that doesn't contain any files you want to keep (the examples erase any data on the diskette). Put the diskette in your diskette drive; if you have two diskette drives, put the diskette in drive B. If you're using DOS on diskettes, be sure the DOS disk in drive A contains the file named `FORMAT.COM`.

PREPARING A DISKETTE FOR USE

As you've seen, the Format command prepares a diskette for use. The diskette can be either new or previously formatted. However, formatting erases any existing files, so be certain not to format a diskette that contains files you need.

In carrying out the Format command, DOS also checks for flaws on the recording surface of the diskette and marks any bad sectors so they won't be used. After formatting, DOS displays a message that tells you the maximum number of bytes the diskette can hold, how many bytes (if any) are defective, and how many bytes are available for storing files. Beginning with version 4, DOS also tells you how much storage space the diskette has in terms of *allocation units* (a term for packages of bytes DOS uses instead of reading or writing from or to disk one byte at a time), and it displays the diskette's *volume serial number* (a disk identifier DOS assigns during formatting). As mentioned earlier, this information is unlikely to be of any concern to you.

DOS knows the type of diskette drive you have and formats the diskette accordingly. That is, it can tell whether the drive uses 3.5-inch or 5.25-inch, standard or high-capacity diskettes, and formats the diskette to match the drive's maximum capabilities unless you specify otherwise.

This does not mean, however, that you can simply put any diskette in any drive and leave the details to DOS. It is up to you to provide the appropriate diskette for formatting. You cannot expect a half-gallon bucket to hold a gallon of water, nor can you expect DOS to format a standard 360 K or 720 K diskette to reliably hold 1.2 MB or 1.44 MB of information.

You can, however, format and use low-capacity diskettes in a high-capacity drive. For example, if you have a high-capacity 3.5-inch drive and run out of 1.44 MB diskettes, you can format 720 K diskettes in the drive and use them reliably in a 720 K or a 1.44 MB drive. If you have a 5.25-inch drive, you can format, read, and write standard 360 K diskettes in it. In this case, though, you should expect to use your 360 K diskettes only in another high-capacity drive; a standard 360 K drive cannot read these diskettes reliably.

The Format command reserves space on the diskette for the directory, thus reducing the amount of storage available for files. Because the size of the directory varies, depending on whether the diskette is standard or high capacity, and because early versions of DOS used either single-sided or double-sided diskettes and in some cases created only eight (rather than nine) sectors per track, the storage capacity of your diskettes depends on both the type of diskette and the version of DOS you use. Figure 6-4 shows diskette sizes, number of sectors per track, and number of bytes available for all diskette drives DOS recognizes.

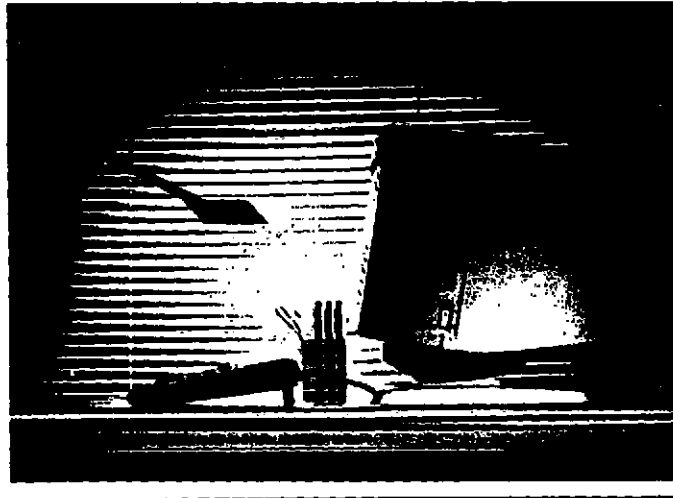
Size	Sides	Tracks per Side	Sectors per Track	Total Capacity	Available for Files	System Where Used
3.5"	2	80	18	1,474,560 (1.44 MB)	1,457,664	IBM PS/2 (except Models 25 and 30); DOS version 3.3 and later
5.25"	2	80	15	1,228,800 (1.2 MB)	1,213,952	IBM PC/AT and compatibles; DOS versions 3 and later
3.5"	2	80	9	737,280 (720 K)	730,112	IBM PS/2 Model 30, IBM PC Con- vertible, and com- patibles; DOS versions 3.2 and later
5.25"	2	40	9	368,640 (360 K)	362,496	IBM PC, PC/XT, and compatibles; DOS versions 2 and later
5.25"	2	40	8	327,680 (320 K)	322,560	IBM PC, PC/XT, and compatibles; all DOS versions
5.25"	1	40	9	184,320 (180 K)	179,712	IBM PC, PC/XT, and compatibles; DOS versions 2 and later
5.25"	1	40	8	163,840 (160 K)	160,256	IBM PC, PC/XT, and compatibles; all DOS versions

Figure 6-4. Storage capacity of different diskettes

Hard and Soft Choices

Mark Landen Crosley

The Architect's Guide to Computer Aided Design
New York: John Wiley & Sons, 1988, pp. 17-33



HARD AND SOFT CHOICES

CHAPTER 2

The technology of small computers has developed rapidly, and architecturally oriented computer programs have followed at a dizzying pace.

Architects entering the CAD world often feel like bumpkins entering a department store for the first time. Making smart choices seems difficult, at best.

Even after choosing a computer-aided design system, you can expect it to evolve as technologies progress and your needs change. Thus, you may

be building a system long after you choose a software package and your first computer. To make wise choices in assembling and maintaining the system, you need to know a few things about each of the individual parts. Even if you are using someone else's CAD system, it's important to be knowledgeable regarding the various parts: you may need to tinker with the hardware, set up the software, or suggest new additions to the system.

AN EVOLVING TECHNOLOGY

It helps to know some recent history. Only recently have computers with graphic capabilities become affordable for most architectural firms. In the 1970s, a few large architectural and engineering firms began using expensive mainframe computers for drafting, often using programs that were written for the automobile and aerospace industries. These programs were not well suited to architecture, so a few design firms such as Skidmore, Owings, and Merrill and Hellmuth, Obata, and Kassabaum wrote their own software. By the mid-1970s, minicomputers, smaller, somewhat less expensive machines, were available that enabled a firm to link as many as a dozen workstations through a single computer, at a somewhat lower cost.

By the late 1970s, software developers like Intergraph and Computervision began to adapt their minicomputer software, originally developed for use by engineers and industrial designers, for architects. These two-dimensional drafting systems still cost hundreds of thousands of dollars to set up and were difficult to learn to use, but many large design and engineering firms decided that computer-aided drafting was useful enough to justify the expense. Unfortunately, they often had to keep drafters working two or three shifts a day in order to pay back their investments.

MICROCOMPUTERS

With the introduction of low-cost "personal" (single-user) microcomputers around 1980, the stage was set for a graphics revolution, and electronic drafting software was quickly developed for the new machines. Personal computers were relatively slow and had stringent memory limitations, so minicomputer software could not be adapted directly. Instead, a whole new generation of drafting software was born.

The first microcomputer CAD systems were, compared to minicomputer and mainframe systems, rudimentary and slow. AutoCAD (developed for IBM-compatible PCs), PCAD (which became CADvance), and CADapple (written for Apple computers, adapted to IBM compatibles as Versacad), were the first programs to gain popularity. Like the early large-system graphics programs, these were intended to be "general use" computer-aided drafting programs, not specifically designed for architects. With hardware prices below \$10,000, including plotters, and software under \$2,000, adventurous designers were willing to overlook some deficiencies. Meanwhile, the minicomputer drafting systems were proving that CAD did indeed have a

role in the design professions; ironically, much of the interest that they generated was directed to the evolving personal computer-based systems.

Almost by definition, microcomputers are capable of less than larger minicomputers. But while they could not equal the speed and capacity of bigger machines, equipment like the IBM-AT pushed personal computers into the CAD big leagues. And a funny thing happened as the PC CAD systems grew up: the software designers, able to learn from larger systems, were forced to write more efficient, compact programs, and they began to produce software that could seriously compete with much more expensive systems.

The distinctions between minicomputers and microcomputers have broken down as the former become smaller and less costly and the latter become more powerful. Gradually, there has been a trend toward "machine independence," so that programs can be used on different kinds of computers and peripheral equipment. Increasingly, large and small systems can work together, but for firms with limited budgets, microcomputer-based systems are becoming a standard tool for drafting, modeling, and a number of other architectural applications.

COMPARING CAD PROGRAMS

A program is a set of instructions that tells the computer what to do. It translates *your* instructions into words or graphics. A graphics program tells the computer how to interpret primitive drawing elements like a line or a circle. It then tells the machine how to actually draw images on a display or a plotter. Finally, a computer-aided drawing program provides an array of "commands" that let you manipulate the elements you create.

DIFFERENT WAYS TO DRAW

Computer-aided drawing programs can be lumped into several categories.

Painting with Pixels

An image is "drawn" on a computer display screen by lighting thousands of dots (pixels) on the screen, according to the program's instructions. A program that maps these pixels individually, storing an image as a grid of dots, is based on bit-mapped graphics, or

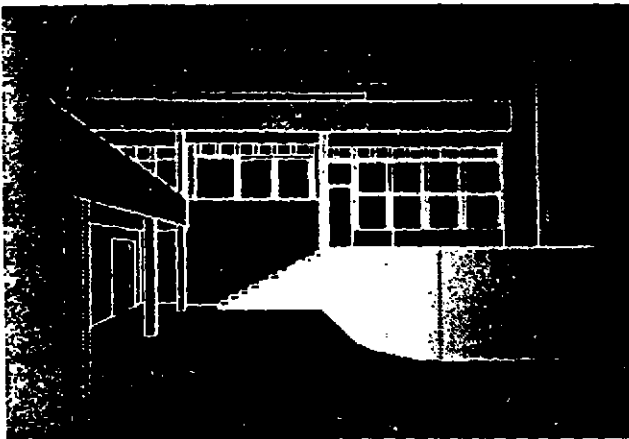
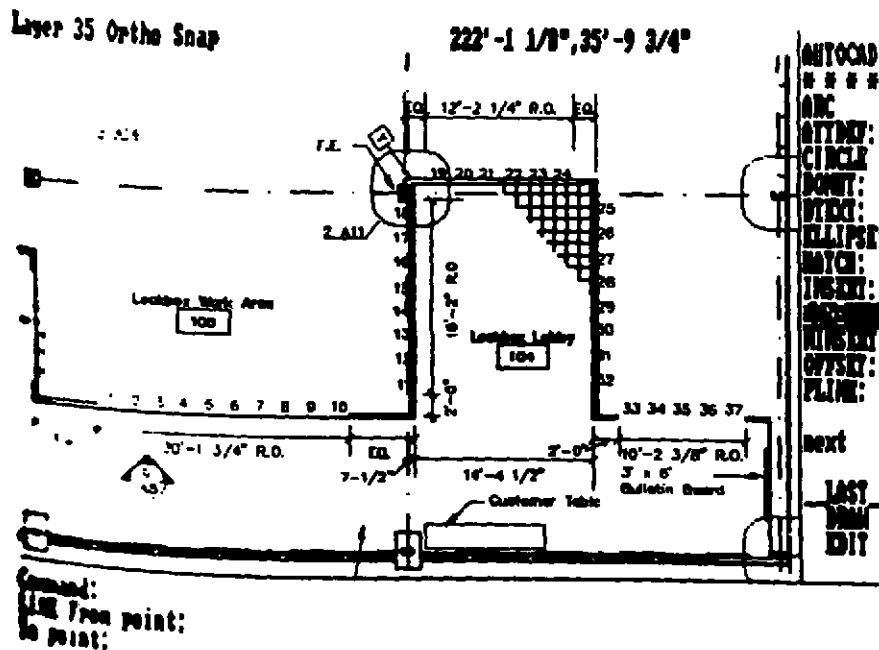


FIGURE 2-1 This image was initially produced as a 3-D wireframe model, then translated into a bit-mapped image and "painted" with MegaCADD's Illustrator software. The program also enables you to create animated "shows" from a series of images.

simply **pixel graphics**. This system is used by paint software and is sometimes used to "render" images that have been created by drafting and modeling programs, after they are translated into a pixel-mapped image (Figure 2-1). Some painting programs can display a series of images in rapid succession to create animation effects.

FIGURE 2-2 An architectural plan, drawn with AutoCAD software. An on-screen menu of commands is located to the right: "line" has been chosen and is highlighted. Commands may also be typed with the keyboard; keystrokes appear on the "command line" at the bottom.

Buday-Wells, Architects.



Imaging systems are programs that can capture and manipulate images from other sources, such as other graphics programs or still images from a video camera or recorder. Pictures of buildings, sites, and people; line-drawings; and shaded renderings can all be combined, stretched and shrunk, cut and pasted together, and displayed or printed. Although these systems are not appropriate for drafting, they can be valuable in preparing presentations and may be used to assemble collages and design studies. Some imaging systems enable you to combine graphics with text, which can be useful in preparing proposals, brochures, and reports.

Vectors

Most programs for architectural design and drafting are based on **vector graphics**. This is a system with which a line, for example, is remembered by its location, direction, and length. Vector graphics are extraordinarily precise, since, unlike bit-mapped graphics, they do not depend on the capabilities of the display: a line is always drawn as a single string of dots, no matter how much you zoom in or out.

Drafting programs are primarily two-dimensional tools for constructing detailed drawings. They generally include sophisticated drawing and editing capabilities, as we will discuss in Chapters 3 through 5 (Figure 2-2). They may also include a projective three-dimensional drawing capability, as we will see in Chapter 6.

Modeling programs allow you to "draw" in three-dimensional space, then extract two-dimensional drawings from your model. Some modeling programs send these two-dimensional drawings to a separate drafting program, while others include their own integrated drafting capabilities (Figure 2-3).

Among all the available computer-aided drawing programs, only some are architecture oriented. Of those that aren't, some are designed specifically for other professions and are not appropriate for architecture. Others are adaptable enough to be used by architects, though usually with extra effort or expense. Some general-purpose CAD programs have been adapted for architecture by the addition of customizing software packages, some of which can transform a general-purpose program dramatically. Programs that are specifically architecture oriented often include drawing tools and symbol libraries that are targeted specifically toward building design.

Adaptable programs have two important advantages over software that can only be used "as is." A program that can be modified or added to is likely to support a thriving market for add-on packages that enable you to do things that the original software designer may never have thought about. Secondly, an adaptable program can usually be modified in-house with a bit of simple programming, if necessary. This may not be a capability you will use frequently, but it's nice to know it's there. Thus, a program that seems underfeatured by itself may be a powerhouse when

built up with add-ons and modification. The catch is that you must be able and willing to put some effort into building up the system.

TRY IT OUT

No two CAD programs work exactly alike, and the capabilities and ease of use can vary greatly from one to another. However, you will find that as you become familiar with one, others will be easier to understand. This book should help you become acquainted with the general principles of CAD and to understand the importance of various features.

The best way to learn about different programs is to spend time using one, then compare the features of alternative programs by reading reviews, manufacturers literature, and especially by talking to experienced users. There are three inexpensive ways to try out some CAD programs. If you know other people who are using CAD, arrange to use their system on nights or weekends. If you have the appropriate hardware available, you can sometimes obtain a "demonstration" version of a program from its publisher. These are generally limited versions of the actual program, with no ability to save or plot drawings. Some programs are available in low-budget, "entry level" versions, which you can purchase to try out. This is not recommended, because these versions often belie the capabilities of their bigger siblings. Also, avoid "canned" dealer demonstrations; they can be easily set up to show only the flashiest features of a program, completely bypassing problematic areas. If you can, arrange for an experienced user to create a simple drawing, start to finish, while you watch. The best help you can get from a software dealer is a list of architects who are using a particular type of software.

It is important that you find software that works the way you work or can be adapted to do so. Consider both your organizational habits and your design approaches: a CAD system will affect both. Try to develop a list of the features that you feel are most important to the way you want to work.

In addition to the drawing capabilities of a CAD program, there are several other areas that you should consider carefully when evaluating software.

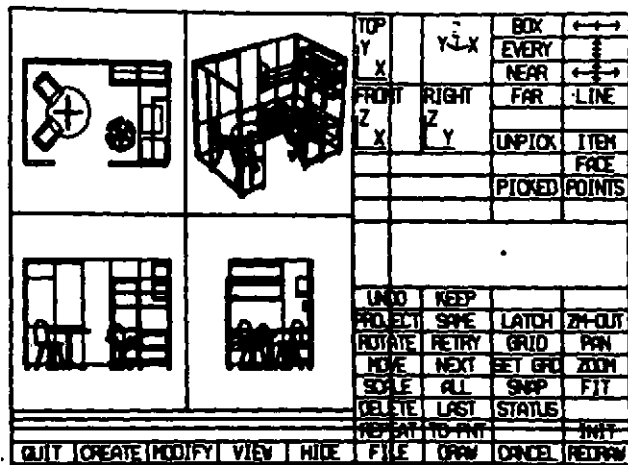


FIGURE 2-3 A three-dimensional model of an office cubicle. On the left side are three orthogonal views (plan and two section/elevations) and a perspective view. On the upper right are boxes for locating and selecting elements of the model; the lower right includes the commands for manipulating the model. Note the cursor, or crosshair, located at "repeat." Courtesy of MegaCADD, Inc.

EASE OF LEARNING, EASE OF USE

Commands are the handle you use to operate a program; the way they are offered to you is the user interface. The interface is what you see on the screen

as you work; it is also the way you give commands to the computer. Some interfaces make a program easy to learn, others are easy to use only *after* you have learned. (Some, unfortunately, are neither.) Ideally, a user interface should be easy to learn and to use.

When you sit down to draw with a computer, you can give it commands in one (or more) of three ways. (Some programs allow only one method, others allow you to choose from several different interfaces.)

First, you can enter commands by typing them in English on a keyboard (Figure 2-4). You must, of course, know what the commands are to do this, either by memorizing them or posting a list nearby. You may also be able to abbreviate commands with single-letter codes, for speed, if you prefer.

Second, you can pick commands from on-screen lists called **menus**. (Menus are illustrated in Figures 2-2 and 2-3.) Usually a program will offer a series of menus that you may step through, from one to another. Since all the commands are displayed in front of you, this is the easiest system to learn, but, as you learn the commands, it will seem somewhat slow, since you must move the cursor (generally crosshairs on the screen) away from your drawing to pick a command, then move from one menu to another. It also takes up valuable screen space, making your drawing smaller.

Third, you can use a digitizing tablet, a sort of electronic notepad, which can also be set up with a menu of commands. The commands are laid out, generally on a grid, and mapped out by a paper or plastic overlay (Figure 2-5). On even a small tablet, a large number of commands can be placed on the menu. Each command can be picked by pointing at it on the tablet with a stylus.

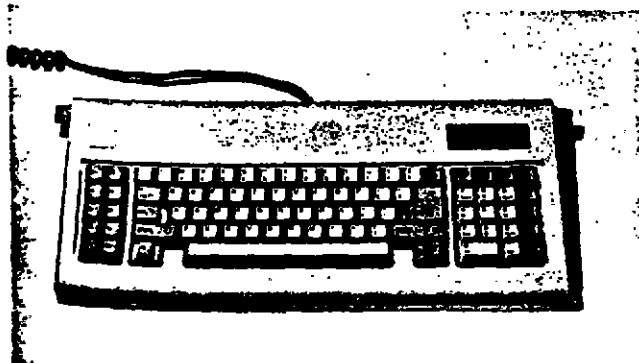


FIGURE 2-4 A typical (IBM) keyboard. Note that the cursor (arrow) keys are combined with the numeric keypad on the right, forcing you to toggle to one or the other. A better arrangement provides separate keys for these two functions.

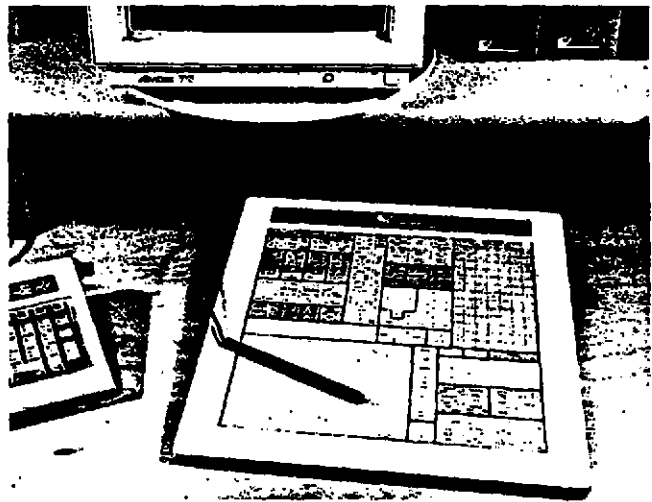


FIGURE 2-5 A digitizing tablet with stylus. The lower left rectangle is used to move the cursor on the screen; the remaining area is divided into a grid, with each small rectangle representing a command. Tablet courtesy of Computervision, Inc.

Each of these interfaces has advantages and disadvantages, so the best system lets you choose among them. Thus, different people within the same workplace can choose their own way of working. Beginners, for example, usually prefer on-screen menus, while veterans often choose to type commands or codes. Even the most typewriter-phobic users tend to use the keyboard frequently, since commands can be entered with the nondrawing hand, without taking it away from the drawing to pick a command.

Easy-to-learn programs are *intuitive*: the commands and command sequences are logical and consistent. Using an intuitive program, you can often figure out how new commands work on the basis of the ones you already know. *Counter-intuitive* programs are inconsistent, and the commands are structured in unrelated or contradictory ways. Some have too many commands or use different names for commands that seem to do the same thing in different situations. Unfortunately, some of the most sophisticated (and expensive) programs are designed with difficult interfaces.

Documentation, the user's manuals and references that are supplied with a program, is also important. Manuals should be readable and organized well enough that, when you are working and need to know something, you can find it quickly. These too are sometimes badly written and can be a tremendous impediment to using an otherwise excellent program. When you are evaluating software, see if the manual is easily understandable: if it sounds like it was written

by someone who does not understand your needs or capabilities, it probably was. Don't blame yourself for being a nonexpert with software you have yet to learn. Be sure that you have some reliable source of information for any software you use, be it the manual, other references or tutorials, a well-staffed user-support phone line, or experienced users who will answer questions.

SPEED

CAD programs vary greatly in the speed with which they can draw images on the screen. Given a very large drawing, some will seem very sluggish when you call for a new screen view, while others are relatively rapid. Since displaying images is often a bottleneck, let's look at the factors involved.

There are two ways a computer can perform the myriad of calculations that are required by a CAD program. Most programs use *floating* (decimal) *point* calculation, which has the advantage of being accurate enough to permit almost unlimited magnification of a drawing but can be relatively slow. A few programs use *integer-based* calculations, which can be performed much faster. However, integer-based programs are inherently less accurate. They can only support a limited amount of magnification, and a user must be prepared to limit the use of a drawing to a range of scales that might go from $\frac{1}{16}$ in=1 ft to $\frac{1}{2}$ in=1 ft.

When you wish to *refresh* a screen that has become cluttered with layout lines or erasures, you can do so very quickly, since the image has been calculated previously and is stored in the computer's memory. However, when a program must recalculate all the information in the drawing, the screen must be *regenerated*, which can take more time. With some programs, this takes place whenever you change the viewpoint by moving in, out, or around the display. Some programs keep a copy of a large portion of the drawing in memory, so that when you change the viewpoint within an area that has been calculated and drawn, the redisplay is very quick, like a simple screen refresh.

A program can speed regenerations in several other ways. First, drawing elements that are outside the display can be *clipped* from the redrawing process, reducing the number of calculations the program has to do. Secondly, the number of drawing layers that must be redrawn can be reduced, usually by eliminating those that are currently hidden, a process sometimes referred to as *freezing* layers. You can determine whether a program uses either or both of these tech-

niques by timing screen regenerations, comparing redisplay times when you move in and out of a drawing, and when you turn layers on and off.

COMPATIBILITY

Before you can use a CAD program, you must start with a "foundation" program called an **operating system**. The operating system tells the computer how to coordinate the machine with your various programs, and it manages the use of the computer's memory, data storage media, and peripheral equipment. Each program you use must be written to be used with a specific operating system. Some computers, though, allow the user to choose from several operating systems, according to the desired software. Many microcomputers use an operating system called MS-DOS, its descendant OS/2, or a more powerful system called Unix. (Some versions of Unix can run MS-DOS *within* them.) For the most part, graphics software is written to work with a specific operating system, but a few programs are becoming available in versions that will work on different operating systems.

Chances are you will not use your computer only for drawing, and you may want to use more than one drawing program. Any time you want two or more programs to work together, you have to consider whether or not they are compatible with each other.

Exchanging Drawings . . .

Programs that run on the same computer, using the same operating system, do not necessarily produce compatible files. In fact, most CAD programs are not directly compatible with each other. Some, however, include utility programs for translating drawings and data into intermediate formats that can be read by other programs. There are several formats that can be used to share graphic information; the most widely recognized is the *IGES* (Initial Graphics Exchange Specification) format. Another widely adopted standard is the AutoCAD *DXF* interchange file format, which numerous other programs can read and write. Unfortunately, only custom-written translation systems can transfer *all* of the information between programs that are inherently different. Data regarding layers and symbols, for example, is sometimes dropped or simplified in translation. It is not always practical to use a system like IGES to link several CAD programs, swapping information every day, unless you are aware of *exactly* what data may be compromised. With this qualification, it is possible, if awk-

ward, to use these interchange capabilities to design a project on two different CAD systems. The primary reason for considering this is cost: an inexpensive microcomputer-based system might be used as a cheap workstation for a more powerful (and more expensive) minicomputer.

... and Data

You may also want to write notes on a word processor and import them into your drawings or export lists of materials to a spreadsheet or database management program. A CAD program must either include these capabilities internally (this software is said to be "integrated") or make allowances for you to transfer such information to and from other programs. Data must, again, be imported or exported in a format that is recognized by other software.

HARDWARE FOR GRAPHICS

In order to use a computer, you need to know very little about the machine itself. Your biggest concern, once it's purchased and hooked up, is how to turn it on and adjust the video display. However, the more you know about what goes on inside, the more you can optimize it to get the most out of your software. As time passes, you may wish to add new hardware to your system. Since only certain combinations of computers and add-on *peripheral equipment* will work together, it is important to be familiar with different types of computers and peripherals.

INFORMATION PROCESSORS

The first "small" computers were the so-called mini-computers: by today's standards they were physically not so small and only moderately powerful. They were made possible by printed circuit boards that could hold a complete central processing unit (CPU), the "brain" of the computer. Previously, the CPUs of mainframe computers had been housed in large cabinets of individual transistors; earlier still (the 1950s), mainframe CPUs had been contained in entire rooms full of vacuum-tube assemblies.

In the early 1970s, the first silicon chips were developed to house computer CPUs. These microprocessors, pocket-sized wafers, could process and store information far more efficiently and quickly than their

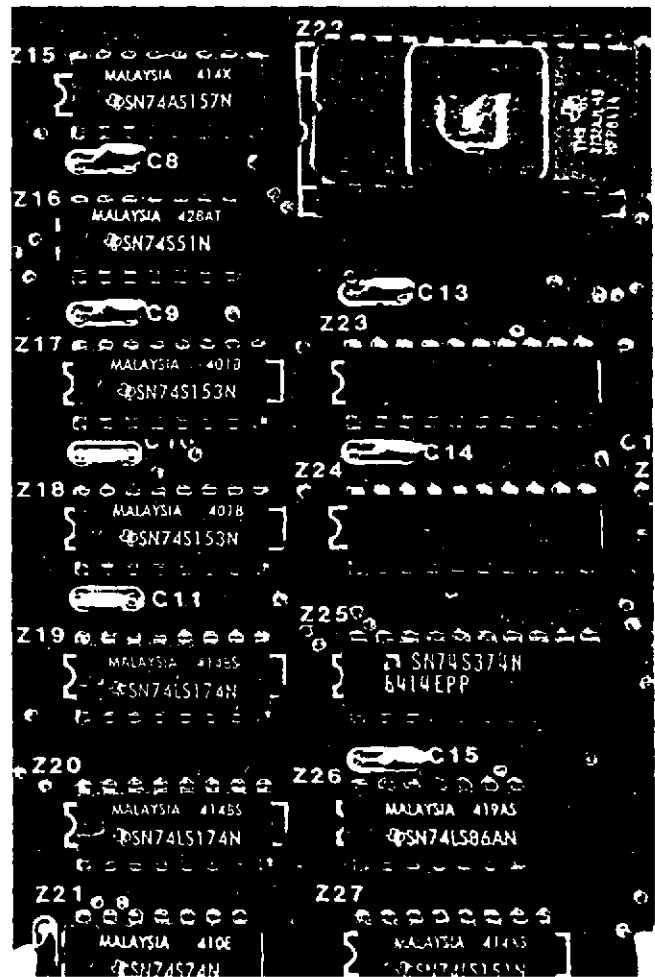


FIGURE 2-6 Chips from a microcomputer.

predecessors. Silicon memory chips were also developed, as well as numerous other specialized chips. Eventually, in the late 1970s, these chips were used to create an even smaller type of computer, dubbed microcomputers or personal computers (Figure 2-6).

The first microcomputers had relatively small processing chips that could handle 8 pieces of information ("bits") at once. Small-capacity processors mean slow computers, since it takes more time to squeeze data through a small processor than a big one. Before long, 16-bit chips were introduced, such as Intel Corporation's 8088, the processor that went into the IBM-PC. Since then, improved 16-bit chips were introduced, followed by 32-bit chips. Specialized chips called *math coprocessors* and *graphics coprocessors* were created to handle the intensive calculations required by engineering and graphics programs.

Minicomputers, too, became smaller and less expensive. They retained major advantages over micro-

computers: they are capable of supporting several graphic workstations from a single central processor, enabling users to easily share information from the centralized source. They are also powerful enough to enable a user to do more than one operation at once, such as drawing, plotting, and database sorting. (This is called **multitasking**.) The CAD systems that were originally developed for these machines became more efficient and affordable. Using the first 32-bit microprocessors, they remained capable of handling larger projects at a greater rate of speed than the microcomputers.

Now, however, the distinctions are breaking down. Powerful 32-bit microprocessors, such as the Motorola 68020 and the Intel 80386, are bringing tremendous capacity and speed to small, affordable computers. They can also offer multiuser and multitasking capabilities. More efficiently designed computers like *reduced instruction set computers* (RISC) are further speeding up the hardware. In the future, even advanced computers will be relatively small, and many will be affordable for even small architectural firms.

REMEMBERING AND STORING INFORMATION

Most computers use two primary ways of storing information—on silicon chips, which reside within the computer, and on media such as disks, which in some cases can be removed from the computer. Internal chip-based memory, called **random access memory** (RAM) due to its quickly accessible nature, depends on uninterrupted electric power. It is used primarily for *working memory*: when the machine is turned off, it loses its information. Permanent storage media, such as diskettes and hard disks, can be used to save your work periodically, as you work, in case of power failure, and to archive drawings indefinitely.

Diskettes are an inexpensive, easily transportable medium. They can be carried from one computer to another, and they can be erased and used repeatedly. These *floppy disks* or *microdisks* come in several sizes and capacities, varying with the computer model (Figure 2-7). Typically, a disk can carry anywhere from one very large architectural drawing to a dozen medium-size drawings. You can also place a very large library of symbols or small drawings on a single disk. Unfortunately, reading from and writing on diskettes is slow. Many programs send information back and forth to a disk, so storing the program or drawing on which you are working on diskettes can slow a CAD program down unacceptably.

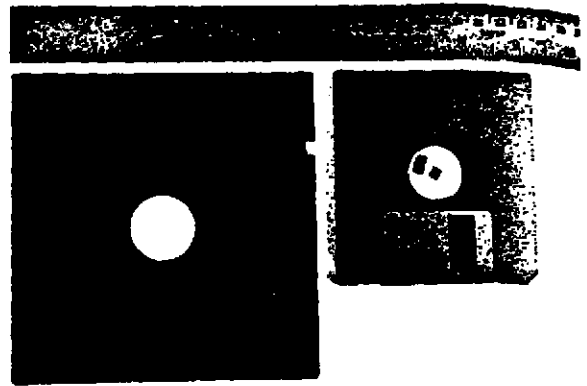


FIGURE 2-7 Floppy disks (left) and microdisks (right) can store dozens of small drawings or single drawings that are very large. For example, all the text for this book can easily fit on one 1.2 megabyte-capacity disk, while the illustrations for Chapter 1 fit on another.

Mass storage media such as hard disks are a necessity for computer-aided drawing. They are faster and have a greater capacity, 10 to 100 times greater, than diskettes. A hard disk is a complete mechanism, not a removable medium. Since they are very delicate they are not as portable and are often fixed inside the computer. Since they hold so much information, they must be organized very carefully. Typically, a single hard disk will contain your CAD program, your drawings, various "utility" programs, and, perhaps, additional software for cost estimating or word processing. Groups of *files* (drawings, programs, and other data) can be organized into *directories* and *subdirectories*, so that you can manage them more easily. Since hard disks are prone to disastrous breakdowns, all important information must be *backed up* onto diskettes or onto tape cassettes. The importance of this cannot be overemphasized: an entire project, or more, can evaporate in an instant if a hard disk fails.

Several alternatives for data storage exist. Large-capacity disks on removable cartridges are like portable hard disks. They are ideal for a situation in which large drawing files may be passed around between workstations, and when it is useful to file a large project on a single disk that can be stored safely. Laser disks are another alternative, with important advantages and limitations. *Compact-disk, read-only memory* (CD-ROM) systems offer vast amounts of storage capacity but cannot be written on directly. They are most appropriate for storing prepackaged, mass-marketed drawing libraries, standard specifications and cost-estimating information. An alternative, CD-WORM (*write once read mostly*) allows you to store

information on a disk, once, that can be read back at any time. You could, perhaps, place a firm's entire drawing output for a year on one of these disks. Laser disks that can be written and erased like floppy disks are also under development.

SHARING INFORMATION

Sometimes you will want to transfer information from one computer to another: there are several ways to do so. The simplest is to copy a file onto a disk, then put the disk in the second machine. This is not the fastest method, nor is it very convenient if the second computer is on the other side of town. If your two computers are compatible with each other and are using compatible software, there are several electronic means to transfer information.

Computers can be linked over telephone lines, or over do-it-yourself internal telephone lines, by using a device called a **modem**. Since these devices send information in a one-bit-at-a-time stream and since they must check for errors, they tend to be slow in sending large files like drawings. Newer models are appearing that operate at relatively high rates of speed, and improvements in the quality of telephone lines are improving the quality of modem links. Modems are relatively easy to use, although they require compatible communications software at both ends.

Within a single building or workplace, computers can be linked directly in a **network**, (or *local area network*). There are various kinds of networks, some very complex, most of which use a single computer as a central storage point and "traffic cop." In addition to being able to share data, such a network can be used to ensure that a single "master" copy of each file is maintained at a central point. Each user at a peripheral workstation can "borrow" the original, updating it at the end of each session. Since each workstation is itself a microcomputer, files can be stored locally, as well. Networks usually require special hardware and cabling, and sophisticated software for managing the demands placed on a single CPU by several machines.

The predecessor to the microcomputer network is the single large computer with peripheral "dumb" workstations, which cannot function on their own. With a sufficiently powerful computer, this setup has the advantage of strict control over the central database. Many of the early CAD systems were written to take advantage of this centralization, allowing several workstations access to a project at the same time. This is difficult to implement in a decentralized network.

SEEING CLEARLY

Most of your computer-drawing time will be spent watching a display screen, so it ought to be as comfortable to look at as possible. Although displays using liquid crystal diodes (LCDs, commonly used in wrist-watches) and electroluminescent screens may eventually produce flat, portable, comfortable viewing, most computer-aided drawing is done on video displays.

A video display is really a two-part system. First, it includes a **monitor**, the box that houses a cathode ray tube, better known as the screen. It also includes an **electronic graphic adapter**, often located in the computer itself, that interprets the signals sent out by the program, translating them into graphic images for the monitor. A monitor must be capable of displaying the images as they are sent out by the adapter: not all adapters and monitors are compatible, nor, for that matter, do all CAD programs work with all graphic adapters. You must be particularly careful in matching these.

Many CAD programs give you a choice of several different display options. In choosing a graphics display, the most crucial variable is **resolution**. Resolution is measured by the number of dots displayed, horizontally and vertically, on the screen. The available range runs from 640×350 (the absolute minimum acceptable for CAD: many people find this too low) to about 1000×1000 or even higher. High-resolution displays are not only more comfortable to look at, but they allow you to see, accurately, *more* of your work at once. Using a low-resolution display forces you to "zoom" in and out of a drawing frequently, a time-consuming process, while higher resolution lets you work at greater levels of detail on a large drawing area (Figure 2-8). (While higher resolution is generally better, some high-resolution systems tend to be slower to redraw their screens, somewhat offsetting the advantages.)

High resolution displays are also well suited to displaying several *windows* at once, dividing the screen into different areas to display different kinds of information. This becomes increasingly important as multitasking becomes more common: you may wish to work on a database management program to edit a finish schedule while you work on a drawing, or you may wish to display two drawings at once, in different windows. If you want to view a large schedule or two complex drawings, you'll need high resolution to squeeze them onto the screen area.

The *size* of the monitor is independent of the

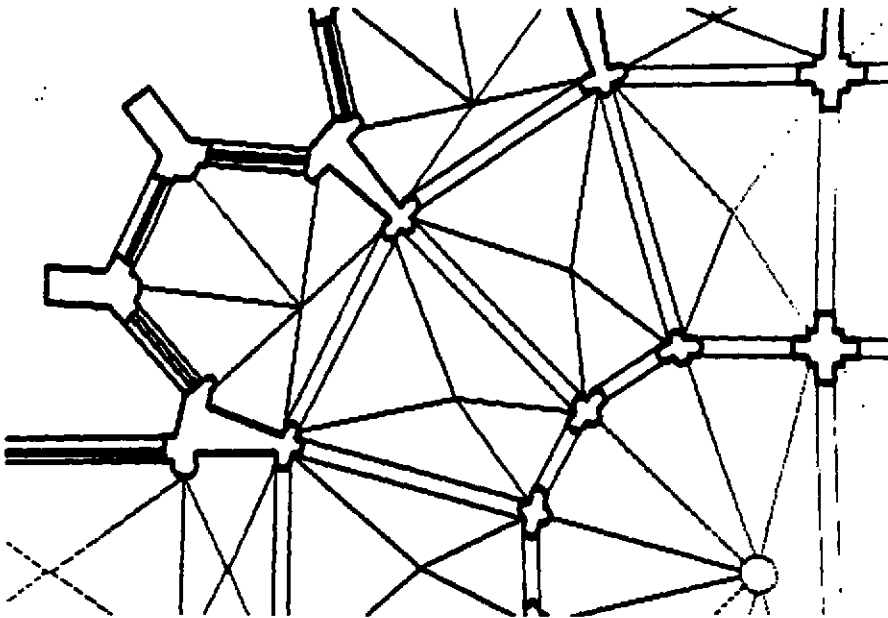


FIGURE 2-8 At a resolution of 640 (horizontal lines) by 480 (vertical lines) on a 13" monitor, diagonal lines and curves are somewhat jagged.

capabilities of the graphic adapter, just as any size TV can display broadcast signals. However, a large monitor is largely wasted on low-resolution output, so monitors of about 13-inch (measured diagonally) are usually used for medium- and low-resolution displays. With high-resolution adapters, most people prefer 19-inch or even 25-inch monitors.

Color displays are an important factor in computer-aided drawing. CAD software is designed to let you display groups of drawing elements in different colors to aid in editing and plotting them; this capability is wasted with anything less than a color display. Rainbows of hundreds of colors are not needed for drafting, but a palette of sixteen or more colors is very useful. If you will be using three-dimensional software that allows surface shading, or image-capture software that offers multicolor rendering capabilities, a large palette can be a valuable design and presentation tool.

Monochrome monitors are useful for displaying text on a CAD system that lets you use separate monitors for graphics and textual information. Not all CAD programs allow this arrangement, but it can be very useful, since it allows the entire graphics screen to be used for graphics. High-resolution monochrome monitors, which display a single color on a black, white, or green background, are less expensive than multicolor monitors. Monochrome is not well suited to layered drawing, since it is difficult to see on which layer an element is located.

HARDWARE

Drawing is a manual activity. Just as a straightedge guides your pencil, the computer assists in putting lines where they belong. But like a pencil or straightedge, computer tools must be comfortable for your hands, and they must allow good hand and eye coordination. As we mentioned above, there are several different kinds of user interfaces available for computer-aided drawing. Each uses a particular type of hardware (hardware?).

Typing and Cursoring

Many architects are not accomplished typists and use the "hunt and peck" method, which is hardly a pleasant way to *type*, much less draw. Although it is probably a good idea for anyone to learn to type proficiently in the computer age, typing skills are not required to use the keyboard effectively for drawing. Touch-typing is not necessary to type one- or two-key codes.

Since a keyboard can be used to write drawing notations and perform numeric calculations, it is more than a means to enter commands. Typed notes and dimensions, which are displayed and plotted according to the typeface you choose, are one means by which you can produce extremely readable drawings. The arrow keys can also be used to move the on-screen drawing

cursor, or crosshairs, more precisely over short distances than a hand-held pointing device.

Talking to the Machine

An alternative to typing commands is *speaking* them: voice recognition systems are available that enable you to talk to your computer instead of typing to it. They consist of a microphone, an electronic board that usually is placed in the computer, and special software that translates voice patterns into words. You can "teach" the computer to recognize a limited set of spoken sounds, generally from one person's voice, and treat each word as if it had been typed. These systems are far from foolproof—a chance remark may have unpredictable consequences—but the idea of drawing without manually entering commands is certainly attractive. While the notion of a studio full of people talking to machines is almost comical, we may see the day when our voices take over many of the functions of hardware, leaving the hands free for drawing.

Mousing Around

Several kinds of devices can be used as electronic pencils. Each is used to move the crosshairs around on your screen. Since they are all used to point to on-screen graphics, they are also a means of picking items from on-screen menus.

A mouse is a hand-held box with several buttons and a tail linking it to the computer (Figure 2-9). By sliding it around on a pad or on the desktop, you can move the crosshairs on the screen. At first, drawing with a mouse feels odd, because you watch the screen, not the drawing tool, as you work, and because the

distance the mouse moves does not correlate exactly to the distance the crosshairs move on the screen. You will get used to these contradictions very quickly; most drafters find mice fairly comfortable for drafting. They are somewhat less ideal for freehand drawing, since they are awkward to move rapidly.

There are two species of electronic mice: *optical* and *mechanical*. The only effective difference is that an optical mouse must be used on a reflective pad, onto which a small light is bounced, while a mechanical mouse can be used on any flat surface. This distinction is inconsequential.

The evolutionary ancestor of the mouse is a stationary directional pointer called a joystick, which is used by a few CAD programs. This stationary device can be pointed in any direction, and the crosshairs move in that direction. Since it is difficult to control the speed of movement, a joystick is not a comfortable drawing tool.

Screen Pointing

A light pen is a pen-sized pointer that is held to the display screen to pick menu items and move the crosshairs around a drawing. In theory, it is the most direct pointing device. In practice, however, light pens have several serious disadvantages. A light pen requires that the user be within a comfortable arm's length, under sixteen inches, from the video screen. However, most video screens are best viewed from about two feet away: any closer can be very tiring for the eyes. Also, holding a light pen on a vertical surface can be tiring over long periods of time. If the screen is tilted or laid flat, the user may be even closer to the screen.

Light pens may become more popular when more mobile, less eye-straining screens become available. High-resolution, low-flicker video screens and other alternatives may make this possible.

Digitizing

Mice are *relative* pointers: they indicate direction but do not measure distance accurately, hence they cannot be used for tracing. In order to copy a paper drawing, you need a digitizing tablet, an *absolute* pointing device.

A tablet is used with either an electronic stylus or a box with buttons (and a tail) that looks, at first, like a mouse. This box, called a cursor, has a pair of crosshairs that travel over the drawing surface, as does the point of the stylus. Since the stylus is much like a

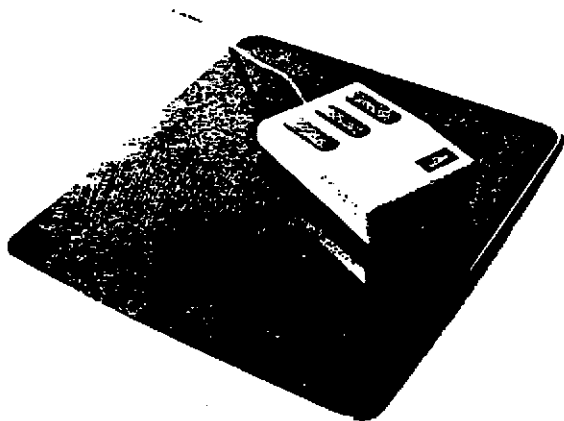


FIGURE 2-9 An "optical" mouse, which registers movement by reflecting a light onto a small pad with a reflective grid imbedded.

pencil, it is favored by many architects (Figure 2-5). Either of these two pointers can be used like a mouse, to indicate direction and to point to drawing elements and menu items on the screen. They can also be used, however, to trace with a very high level of accuracy, as well as to pick commands and symbols from a menu that is overlaid on the tablet.

When you trace a drawing on a digitizing tablet, you use the same drawing procedures that you use in normal computer-aided drawing. To copy a line, for example, you pick the endpoints. You can use the built-in accuracy of the CAD program to actually improve the accuracy of the original, by making lines and objects conform to dimensional requirements. A good tablet is accurate to about 0.001 inch. If your drawing is bigger than the tablet, you can shift the drawing across the tablet, then, give the computer two reference points from an overlapping area: the drawing will be automatically aligned. Even a small 12-inch $\times$ 12-inch tablet can be used effectively this way, although the larger the tablet, the less shifting you must do. If your work involves large amounts of tracing, a large tablet may be a good investment.

Tablet menus can be purchased with some architectural software, and many programs allow you to create your own menus. The surface is divided into a grid of boxes, and each box is assigned a meaning, which is invoked when you point to it. A box may contain a command, a sequence of commands, or a graphic image that you can insert into your drawing. A 12-inch $\times$ 12-inch menu can contain most of the commands used by a program, with room for a number of special boxes for command sequences (*macros*) or graphics. A small area, usually about one-fourth of the surface, is reserved for a blank space on which the stylus or cursor can be used in "mouse" mode, dragging the on-screen crosshairs.

HARD COPY

Once you create an electronic drawing, you usually need to find a way to get it onto paper, velum, or mylar. In architectural practice, you need to be able to reproduce your drawings at large size, reasonably fast, and with great accuracy. It doesn't hurt if they're beautiful, too.

Printing

Graphic printers are the quickest way to reproduce a drawing. Images are produced by printing dots onto paper, very small and very close together, one of three

ways. A printhead with 8 to 24 pins can be used to strike a ribbon; an ink jet can squirt patterns onto the paper directly, or an electrostatic process, using a laser or LCDs, can produce images in a manner similar to photocopiers. In each case, the software must translate the vector graphics into a matrix of dots, a process called *rasterizing*.

Pin *impact* printers are limited in resolution by the mechanics of the tiny pins. When you need a quick record of a drawing, and you are not concerned with detail, a mechanical dot-matrix printer will often suffice. Since they are also good for printing text, such as lists that are created while you draw, it's a good idea to have a basic dot printer handy. Although some can print in color by using multicolored ribbons, they are inherently too small and too low-resolution to produce high-quality architectural drawings.

Ink jet printers share most of the advantages and problems of pin printers. They are generally used for text and medium-resolution graphics. However, jet printers have the potential for producing higher resolution drawings at large sizes, and they may find a greater role in architectural graphics than they currently play (Figure 2-10).

Electrostatic dot-matrix printers are relatively expensive, but they are both fast and accurate. Small, desktop laser printers have sufficient resolution to produce architectural details and small presentation drawings, while doubling as letter-quality printers. Large electrostatic plotters, which are essentially huge dot printers, can be used for most architectural drawings. Because they are extremely costly, they may

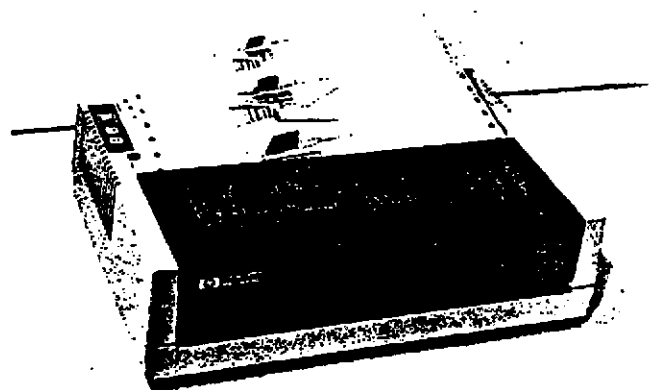


FIGURE 2-10 An inkjet printer, capable of very quiet operation and able to produce medium-resolution graphics (192 dots per inch, compared to 300 dots per inch for a typical laser printer).

be available only to large firms or through reprographic services in the near future.

Plotting

Pen plotters are the kind of tool that you curse when something goes wrong and brag about when everything works. A good pen plot, using several pens to create different line weights and colors, can be strikingly attractive. The quality of diagonal lines and curves that are produced by a good pen plotter is vastly superior to any dot-matrix medium. (Most of the drawings in this book were produced on a pen plotter.) (Figure 2-11)

Large plotters move a sheet of paper under the pen in one direction, while the pen is moved in the other direction. (Smaller plotters move the pen, on a bar, both directions.) Low-cost plotters often move the pen in short, visible "jumps," making diagonal lines into

"stair steps," just like a dot printer. A good plotter will produce smooth diagonals and curves. Multipen plotters will automatically change pens according to your instructions, although single-pen plotters will stop to let you change pens manually. You can use either technical pens or inexpensive felt-tip pens.

Pen plotters have several distinct disadvantages. Most plotters operate at several speeds. At the highest speeds, the pens move at a blazing rate of speed, almost too fast for the eye to follow, but it still takes a long time (5 to 45 minutes) to plot an architectural drawing. They tend to be noisy, so that you will probably want to put them in a transparent soundproof enclosure. Why transparent? Once in a while, usually when you are in a hurry, a pen will clog or run out of ink, usually necessitating a new plot. Thus, you will want to check on the progress of a plot as it proceeds. Still, when it comes out right, you will usually be pleased.

HARDWARE COMPATIBILITY

Computers and peripheral equipment such as displays, plotters, and printers suffer from an unfortunate lack of complete compatibility that must be resolved by programs. As a result, a program that produces beautiful results on one plotter may produce incomprehensible garbage or nothing at all on another, so programs thus must include *drivers*, subprograms that tell specific peripherals what to do.

Since it is difficult to write drivers and since so many peripherals are available, some software writers have chosen to support only a few pieces of equipment, in essence endorsing a "required" workstation. Some of these companies sell "all or nothing" software-hardware packages: if you want the software, you must buy a specific hardware configuration. Others support a wide range of peripherals, allowing you to "mix and match" to design your own workstation. Given the price competition that exists among hardware manufacturers, the advantages of this approach to the user are obvious.

Sometimes the most popular hardware becomes a "standard," as has happened with IBM-compatible computers. Unfortunately, the standards are not always the best solution, as in the case of the popular medium-resolution IBM Enhanced Graphic Adapter. A better solution is a multipurpose hardware-software link that allows any program to communicate with any piece of equipment. Several of these standards have been proposed, and some are in use in various forms. Until such standards gain wide acceptance, software that supports a variety of peripherals is a good choice.

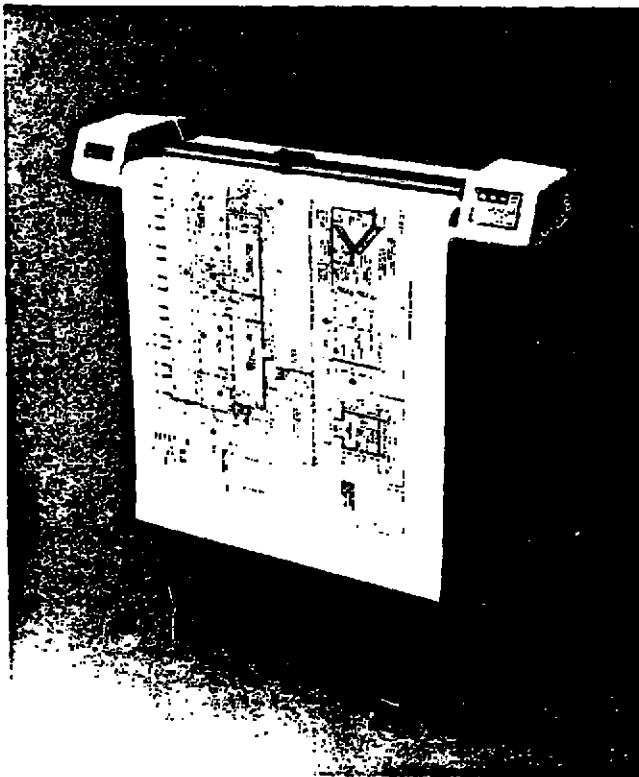


FIGURE 2-11 A single-pen "C" and "D" sheet-size plotter, also available in "E" size. This is a plotter that most small firms can afford. Yet it plots without the visible "steps" that some low-end plotters produce when drawing diagonal lines and curves. Most of the drawings in this book were plotted with this plotter. Courtesy of Houston Instrument Division of Ametek.

CHOOSING AND USING CAD

HOW MUCH . . . AND WHEN?

The rapid development of computer-aided drafting and design can be expected to continue in the near future. Why, then, begin using something that will be "obsolete" in a year or two?

Most important, as we explained in Chapter 1, CAD is a tool that is already useful, even if you buy a system and never upgrade it. The *payback* time, the period in which your costs can be recovered through labor savings, is relatively short for PC-based systems.

Also, if you choose carefully, you can pick both hardware and software that will evolve as standards and capabilities change. Today's state-of-the-art computer can be tomorrow's training and plotting workstation; usually your software can be upgraded to newer versions at less than full cost.

What kind of criteria should you use when you choose or upgrade a CAD system? Here are some suggestions:

Cost and Style

"Cost" is an elusive issue in architectural computer systems. Prices for hardware and software may vary widely from one system to another, but these capital costs will eventually seem almost trivial compared to the investments you make in training and in building up libraries of drawings and data. Architecture is labor-intensive work, even when you use computers, and the ease with which people in a firm can learn and use a system will determine its ultimate cost. Many architects have made the mistake of buying low-budget hardware or software, only to find themselves spending great amounts of time making up for shortcomings. Once you know what your needs are, try to fulfill them: if you go halfway you will probably end up going the rest of the way sooner or later, possibly at a greater overall expense.

Pick your software before you pick your computer. Find a program that will do the kind of work you want to do and is easy to learn and use. Ease of use requires that the computer help you to work in a way that feels comfortable and suits your "style" of working. Plan on doing some self-analysis as well as software analysis: try to sort out which working habits you want to keep and which you would like to get rid of. (More on this in Chapter 8.) If you are choosing CAD software for a design office, consider whether or not your firm will be

able to hire people who have used a particular software package. Experienced people can not only save you training time, but they can help set up your system.

After you find the right software, then find a computer on which it will operate. Some programs are designed for *dedicated* systems, which are specifically assembled for the software. This is becoming less common, and chances are that any program will operate on several different computers.

Speed is essential. A slow CAD program will make you feel like you are drawing in molasses. It is impossible to overstate the importance of a speedy CAD system: if you find yourself waiting every time a drawing is displayed on the screen, you will eventually begin to lose your concentration and become frustrated. The rate at which a drawing appears on the screen is a function of both the hardware and the software, as we explained. In order to evaluate both, learn a little about what makes the machines different, then try the same program on several computers. Try different programs on the same machine. Use a complex drawing and a stopwatch to test the time it takes for different combinations of hardware and software to perform simple operations, especially tasks that require a drawing to be redisplayed from scratch. You will always want a faster system, so start with the fastest you can possibly afford.

Growing

Plan strategies for growth. Assume that you will want to purchase upgrades of your software and budget accordingly. If you expect that, as you become more experienced, you will want to move up to more sophisticated software, develop criteria so that you will know when you are ready. Most important, if you foresee this sort of growth, get an idea of the software to which you will want to upgrade and make sure your initial purchase is compatible. You should be able to transfer your drawings from one to the other, so you don't lose all the work you put into developing libraries of drawings. Then, either plan to move to a system that can use your hardware, or plan to sell the hardware. Remember that hardware too can be upgraded, by installing add-on options and switching peripherals like plotters and video displays.

Shopping Around

One of the benefits of PC-based CAD systems is the ability to mix and match computer hardware. While most minicomputer systems force you to use a prede-

terminated setup with a predetermined price, microcomputers are available with many options for both price and performance. Unfortunately, the number of options can be bewildering.

The best way to shop is with a shopping list, and a computer shopping list can serve as a specification for comparing and purchasing hardware. It can be used to ensure that your system meets specific standards, and that, if you visit different dealers, you aren't comparing apples and oranges.

Buying computer hardware is difficult because, like automobiles, there are many models available that look the same and accomplish more or less the same function, but do it at different levels of efficiency. There are also different levels of prices, and they don't always correlate to quality. It's always tempting to buy well-known brand names, but even IBM, often considered the safest choice of all, has marketed mediocre hardware at premium prices. If you're careful, it's possible to buy "no-name" brands that work as well as or better than their more familiar competitors. But since it's also possible to buy defective hardware from companies that may be out of business when you call for help, caution is in order.

There are three things to look for when you put together a computer shopping list: *compatibility*, *reliability*, and *numbers*. Each of these can be written into your shopping list.

There are three ways to ensure compatibility: read the documentation for each element; try out the specific combination before buying it, and, finally, write an agreement with the dealer guaranteeing compatibility of specific elements. If you can't do all three, be sure to do the latter; it can be part of your shopping list/specification.

Reliability is often hard to evaluate; often hearsay and magazine reviews are all you have to go by. However, if you can't ensure reliability, you can ensure that you're not helpless when your computer breaks down. First, make sure you have a reasonable warranty and run your hardware hard during the warranty period. Second, be sure you can get prompt, *local* service, even after the warranty expires. Finally, if you have any reason to doubt that the manufacturer will be in business in a year or two, be sure that service and parts are available from another source.

Numbers are the exact specifications of the hardware, and they should be the centerpiece of your shopping list. Each component of a computer system can be evaluated in terms such as speed, capacity, resolution, size and options, and you can use these ratings to specify the minimum performance that is acceptable to you.

Performance Specs

The concept of performance specifications is familiar to most architects and engineers. Essentially, it is a list of criteria that defines standards to which a product must measure up. A supplier can sell you any brand of merchandise, as long as it meets or exceeds the specifications. Applied to computer purchases, performance specs can enable you to submit a detailed shopping list of hardware and receive a price bid for equipment that meets your needs while allowing the dealer to assemble the lowest cost system.

Performance specs can be applied to a long list of CAD hardware, including the computer (CPU), memory-expansion boards, floppy disk drives, graphics adapters, monitors, pointing devices, modems, plotters, and printers. Each of these items has several crucial variables that can be used to describe what you need, without specifying a specific brand.

Just as in writing specs for a building, the completeness and accuracy of hardware specifications is vital. Processor speed, data storage capacity, display resolution, and other similar concepts are crucial to assembling a good CAD system. There is no fixed set of criteria, since standards are generally improving all the time. You may want to write specs for several systems, from the best you could hope for to the minimum you can accept, and compare prices. If you do your homework, you can write computer specs yourself without becoming an electrical engineer, but if you don't have the time or inclination, you can get help from an experienced CAD-user or a knowledgeable consultant, just as you might go to a professional specification writer for building specs.

If you spend some time reading the computer magazines, you can do a pretty good job of putting computer specs together by yourself. Most magazines review hardware frequently, often publishing charts with which you can compare features. You can get an idea of current discount prices by reading the ads. Since you have (presumably) selected your CAD software *before* picking the hardware, pay close attention to the requirements and recommendations that come with the program. Try not to include brand names in your specs, except in reference to standards, such as "Hayes compatible," "includes Postscript capability," or "AutoCAD driver available."

Making Decisions

After you receive bids from dealers, compare both prices and whatever "extras" are included. For example, if two price bids are equal, one might offer, say,

better repair service than you specified. Also, once you get a bid, check the specific brand names very carefully: if you (or your consultant) aren't comfortable with a manufacturer's reputation, or with magazine reviews of their products, think twice. It's also a good idea to try out items like keyboards (their "feel" varies tremendously), monitors (are the colors OK?), and plotters (how noisy is it?) before buying.

MAKING THE SYSTEM FIT

If you are going to draw and design effectively, you should not have to worry about distractions. Using a computer, you should make sure *before you start working* that all the mundane software setups are taken care of, and that your hardware is ready to use. When everything is organized, get comfortable!

Setting Up

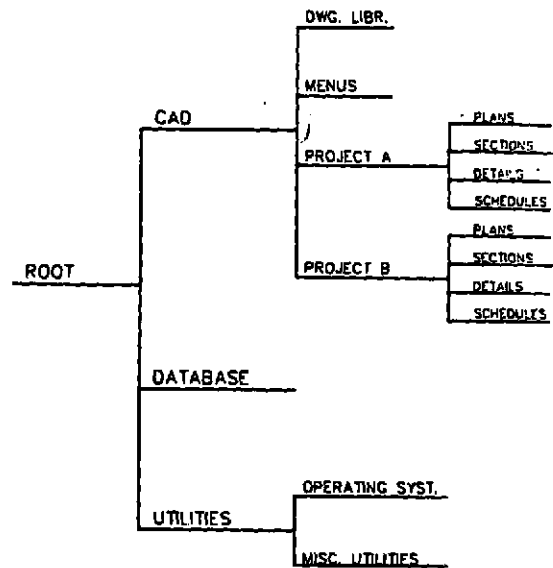
Computers can hold vast amounts of information, but they can also lose vast amounts of information. Short of disastrous breakdowns, it's possible to simply lose track of important files or even to forget how to start up your CAD program. In a firm in which more than one person is using the CAD system, staying organized is especially important.

Start by making sure your hard disks are organized in a clear, efficient manner. When you create directories and subdirectories, think of them as a *tree* structure, starting from the *root* directory, with each directory containing related subdirectories. For example, your CAD directory might contain a subdirectory for each project you are working on (Figure 2-12). Draw a map of the directories and post it so that everyone who uses the machine can see it. Also, be sure that each individual graphics workstation is set up in a similar way, if people will be moving from one to another.

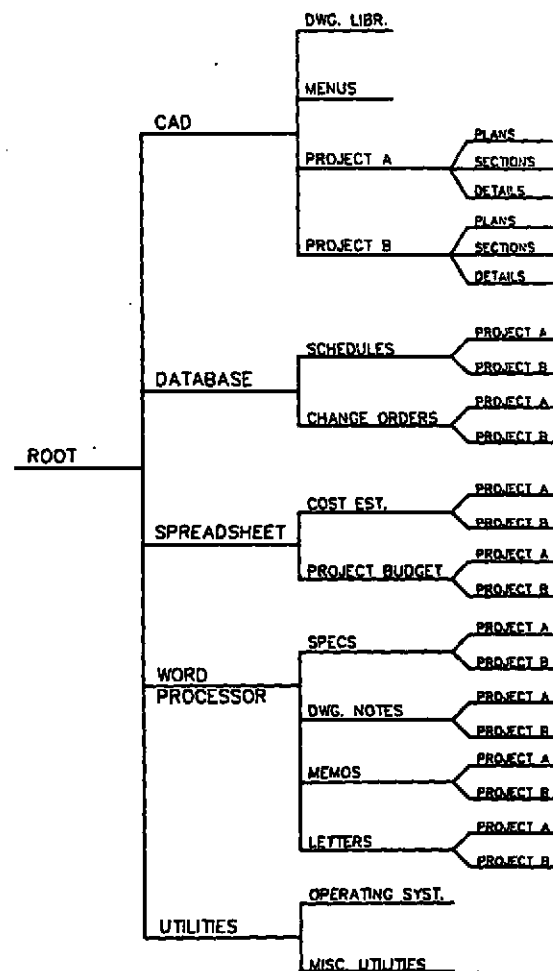
Personalizing the Operating System

When you turn on a computer, you are greeted by the operating system, unless the machine has been set up

FIGURE 2-12 Two alternative directory structures: the first (a) stores the CAD program and a database management program in the first level subdirectories, then places each project in its own CAD subdirectory, with further subdirectories for each drawing type. The second (b), which is more appropriate to a very large hard disk, contains four primary program directories, and subdirectories for each type of task for the nongraphic programs.



(a)



(b)

to take you straight into a program. The operating system may present something as uninformative as "A>" or "C>," referring to the current disk drive, leaving you to give it the appropriate commands. There are two ways to deal with this situation.

First, you should learn to use the operating system. Even if you have an aversion to using codes and seemingly arcane procedures, an understanding of the ins and outs of the operating system will enable you to manage your programs and files much more effectively. You will also be able to set up automatic sequences (called *batch* files) that simplify starting programs and backing up files. Not *every* user needs to be an expert, so you can write batch files that insulate novices and computerphobics from the operating system.

There is a reasonable alternative (or supplement) to learning all about operating systems. "Front-end" programs are available to give you an intuitive, visually oriented handle on the operating system. Typically, a front end gives you menus of commands to choose from and will list the directories and their contents for you. The more sophisticated front ends add new commands that go beyond the capabilities of the operating system: some enable you to operate several programs, on screen, at once. These utility programs are useful for even a computer veteran, to simplify necessary computer housekeeping.

Configuration

Once your computer is set up, make sure that your CAD system is ready to use. Peripheral hardware should be in place, and your program should be *configured* so that it knows what it is attached to. Most programs are set up so that you can configure them by responding to a set of on-screen queries regarding your peripherals. Get connected: you should not have to hook up or configure tablets, printers, or plotters while you work.

During the configuration process, you may also be given a choice of different menu and display options. Drawing and designing are very personal processes, and you should set up the system to suit your own working style. If different people will be using the same machine, you can write macro "scripts" that will automatically reconfigure the system to the liking of each user.

A Comfortable Environment

Most important of all, make sure your working environment is comfortable. Don't just place a computer on the nearest drafting table: put the screen at a comfortable



FIGURE 2-13 This workstation reserves plenty of space for drawings. If space was a problem, the computer could have been placed on its end under the table, and the monitor placed on a swivel arm, which would make it accessible from the drafting tables, as well. Neeley/Lofrano Inc, Architects, San Francisco.

viewing height, preferably on an adjustable arm, and make sure there are no lights or windows reflecting on it. If the monitor is moveable, you can adjust it to changing light conditions and reorient it as you move around at your desk. A simple nonreflective glare shield can prevent headaches where overhead lighting is a problem.

Leave enough desk space for a mouse or tablet, keyboard, and large paper drawings (Figure 2-13). If you can, keep the computer itself out of the way: you only need to reach it to occasionally insert and withdraw diskettes, so don't put it in the middle of your work area.

Moving around and taking breaks is important when you're working at a computer. Try to take short breaks when the computer is busy saving files or redrawing the screen: rest your eyes and walk around. Muscle fatigue can result from sitting too long in one position. If you are using a small digitizing tablet or mouse, you have more mobility than you do when you work on paper drawings: as long as you can see the monitor, you can move around at your desk or sit back, put your feet on the desk, and draw with the tablet or mouse in your lap.

Finally, treat yourself to a comfortable chair that supports your lower back and posterior. A computer program is not the only soft ware that needs support.

The Electronic Workspace

Mark Landen Crosley

The Architect's Guide to Computer Aided Design
New York: John Wiley & Sons, 1988, pp. 163-177



THE ELECTRONIC WORKPLACE

CHAPTER 8

There are no right and wrong ways to use a computer-aided design system, any more than there are right and wrong ways to design buildings or organize design offices. No two firms function identically, so there's no reason to think that one CAD strategy will work for everyone. Some ways may be more conducive to design work, others to production, and others may simply feel more comfortable. "Comfort" may seem like an intangible notion, but it is tremendously important in matching people and tools: CAD should fit your working style so that

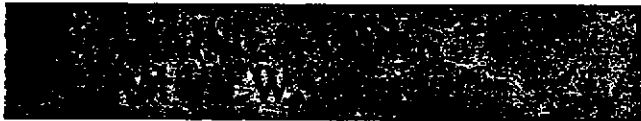
you are hardly aware of its presence. If the tool doesn't fit, you may have to change either your style or your CAD setup; over time, they should evolve to fit each other.

Computer-aided design affects many of the most fundamental practices of a design firm. In addition to changes in design and drawing techniques, it imposes new roles and new routines on drafters, designers, managers, and support staff, in large firms and small practices alike. Some of these changes may significantly simplify

day-to-day operations, while others may seem like bothersome concessions to automation.

Don't expect CAD to automatically organize your office: you have to do that. If your organization is a mess, using a computer will only automate your mess. Instead, do some thinking about how you work, what you do effectively, and what you do poorly. Whatever you do well, make sure that the

CAD system will support it, not change it. Adapt the system as much as you can before you change what you are doing well. Try to use the transition period as an opportunity to improve problem areas. If you need to work on, say, drafting standards or project management, you can focus on these aspects of computer use. Use the tools to work on the problem, but don't expect tools to solve problems by themselves.



Design work inevitably requires a focus on the project at hand: it is often difficult to make plans beyond current work and marketing targets. For many firms, the most important planning concerns personnel—how many employees to maintain and how to keep them busy. Since architecture has been a labor-intensive profession, with relatively small equipment investments, this is to be expected.

Computers are among the most expensive investments some firms will ever make, so they require careful long-term planning. Not only can the initial costs of computer-aided design systems be high, but there are the continuing expenses of upgrading hardware and software, adding new workstations, and training people. Long-term planning is required for financing these investments, and strategies must be carefully developed for upgrading and expanding. Since architectural firms depend on an often-unpredictable flow of projects, planning ahead can be difficult. Add to this the ever-changing technology of computer hardware and CAD software, and you have a daunting planning task.

By setting up goals for the purchase of equipment and the training of personnel, then adapting these goals according to actual events, a relatively steady plan can be maintained. Develop a formula for timing new purchases, based on the amount of work to be done, the number of people and the rate of training, the amount of cash on hand, cash expected, and acceptable

levels of debt. As each new project starts, the plan can be checked against the project's requirements ("do we have enough workstations?"), possible conflicts with other projects ("how do the schedules compare?"), and cash flow ("can we buy that new workstation now?"). In short, the process is similar to the traditional personnel hiring process, except that the long-term goals and financing commitments take on an increased importance.

FOUR STAGES

The introduction of CAD into a new setting seems to follow a four-stage process in large and small workplaces alike. Although the amount of time spent in each stage varies, the sequence seems almost inevitable.

First, when CAD arrives, a few people concentrate on learning to use the system and getting it "up to speed." Often these are the people who initiated the move to CAD or helped choose the system; sometimes they are people who have previous training, either in another workplace or in school. They are not necessarily people in management positions and are frequently at or near the entry level. Whatever their level of experience, the early users are either experienced with computers or are interested in exploring a new way of working and generally have a great deal of enthusiasm.

Meanwhile, the rest of the firm is usually interested in the system, but somewhat uncertain or nervous about it. There is often apprehension about the changes CAD will bring. In a larger firm, management will

want to see results, but may not wish to get directly involved.

Second, there is a learning period, in which the general level of enthusiasm grows, but with occasional disillusionment. Since experience is low, there is much hit-or-miss usage as people discover what tasks the software is most appropriate for, and learning occurs largely by trial and error, with tips and cautions passed along verbally. There are often unforeseen expenditures, as training and purchases proceed on an ad-hoc basis. Projects, and pieces of projects, are often assigned to CAD randomly or according to personnel and equipment availability, with frequent changes in plans.

Third, there is a period of retrenchment as management feels a need to control expenses and scheduling conflicts. New controls are developed: more planning goes into deciding which project can best use CAD, criteria for setting up project teams are modified to emphasize computer skills, and project managers and project architects begin to become more familiar with the system. With experience, careful budgetary controls based on long-range plans are instituted, with procedures for modification over time.

Finally, the computer system becomes an accepted tool that requires little extra planning. Training is complete at all levels; teams know when to use CAD and when not to; scheduling is routine, with procedures for handling conflicts and charrettes. When budgets equal expenditures, management can virtually forget about the system, until a new level of technology comes along that may begin the process all over, but with the benefit of several years of experience with computer-aided design. CAD systems, like any other asset, must eventually be replaced, so the four stage process may become a cycle.

Every firm wants to arrive at the last stage as quickly as possible. The process can be speeded somewhat with the assistance of experienced people and the institution of a thorough training regimen, but nothing can substitute for actual project experience and careful evaluation of the results, followed by planning that uses the insights and talents of all involved.

STARTING ON THE RIGHT FOOT

As you introduce CAD into a design practice, it's crucial that you know from the start exactly what your goals are, even if they change as your experience grows. If your primary concern is automating drafting, then focus on this; if you have secondary goals,

then set up a timetable for reaching them. CAD can be used for many purposes, but you don't have to master them all at once.

An incremental approach might start with the aspect in which you most need to increase productivity, such as drafting plans, then gradually move to elevations and sections, then details, then begin full use of attributes, and finally a move into schematic design and three dimensions. Alternatively, you might choose to begin with an aspect you find the most interesting, say three-dimensional modeling, then begin producing presentation drawings, and finally move into two-dimensional drafting. The choice is up to you, but be sure you have good reasons, and try to plot a course in advance.

In a design firm, scheduling is based on the flow of projects as much as it is based on the calendar, and a CAD implementation program should recognize this. Try to choose projects that are appropriate to the aspects on which you will focus, but also be sure that you start with projects that are limited in size and not overly ambitious in schedule. There is no need to start with a project that will be designed and drawn completely on CAD; it may, in fact, be months or even years before you reach that point.

Even more crucial than *what* you will begin with is *who* you will begin with. We will examine, below, the various roles that people play in using a CAD system, but the most important factor is that people be interested in using the system. You can't force someone to use CAD, so the most effective way to introduce it into a firm is by letting the people who are most enthusiastic try it first, hopefully sparking interest in others. In addition, it is important that, from the start, CAD use not be limited to entry-level drafters. Everyone on a project team should be familiar with the CAD system; it is especially important that a project architect or project manager know its capabilities and limits, and these are best learned through direct experience.

Start Slowly

Perhaps the most important rule in starting out with computer-aided design is to *start slowly*. It can be very tempting to plunge into a big job with a new system, expecting an efficiency increase that will compensate for initial learning-time. This reasoning is particularly seductive if the job is being used to "pay for" the system. Whatever the circumstances, *don't start with too much riding on the job*.

In a large firm, it's usually a good idea to have someone around who has some experience with CAD to shepherd people through the learning process, to set up

the system, and to help establish office conventions. In a smaller firm, this may not be feasible and is not necessarily as important. A small office is better suited to learning by trial and error, and information is shared more easily.

Training

When all CAD software was terribly difficult to learn, it was standard practice to train "CAD operators" outside the office, sometimes in far-away training centers. It could take anywhere from weeks to months of training to achieve proficiency, and when these people returned they were inevitably pigeonholed as specialists who were too valuable to do anything else. As CAD has become easier to use, the time required for outside training has been reduced to days (or eliminated), and training programs have appeared in most cities. Since CAD is now taught in most architecture schools and drafting programs, new employees often need no further training. They can often help introduce new techniques to co-workers.

It is not unreasonable to learn to use computer-aided design and drafting on the job, in the office, especially if there are experienced people around. All that is required is employee time, computer time, and a willingness on the part of the firm's management to support the learning process. The latter is particularly crucial, since pressure from one's boss to "produce" can make learning more difficult. Set aside time specifically for training people, and allocate a budget for covering training time. Since the firm will benefit from improved CAD skills, everyone, from an entry-level drafter to a project architect, should be fully paid for learning time.

"On-the-job training," for an individual or an entire firm, can be handled through a series of tasks. A novice should start with a short period of simple drawing operations to become familiar with the software and the manuals. This may begin with simple line-drawing, continue with a taste of each important feature, and end with drawing something that is of personal interest. This point can be reached in a day or two with easy-to-use software and an experienced co-worker or instructor available. After this, a student can begin working on useful work like developing drawing libraries or pieces of projects, *without time pressure*. It's a good idea to keep a list of noncrucial projects for training purposes. Finally, it is helpful if a beginner can spend some time on a project that has few time pressures before moving on to normal work. While this may not always be possible, it is highly desirable. The more time you have to explore the capabilities of the system, the more you will be able to take advantage of

it. This applies to experienced people as well: try to reserve some time now and then to experiment. Allocate time (and a training budget) for this.

There are two drawbacks to on-the-job training. First, it takes longer than attending a training program, which is geared toward fast instruction. Second, it requires the use of valuable computer time. If the office is busy, it may be impossible to assign a workstation to training. Inevitably, workstations that are purchased for training purposes are taken over for jobs when things are busy, so you may be forced to choose between a flexible training schedule and sending people to a training site outside the office.

Outside Assistance

A compromise alternative is the use of a service bureau, especially when you are starting out with CAD. A service bureau is a drafting service that will produce drawings for you. Usually, drawings should stay "in-house" through production, but a service bureau that uses the same software as your firm can often provide suggestions, training, and general hand-holding as you get started. If you get into a pinch, they may be able to take over a drawing and finish it quickly. Even after you no longer need drawing assistance, they can continue to provide training services.

COSTS AND BENEFITS

Let's look more closely at some of the less obvious factors that need to be considered in evaluating a computer-aided design system.

The initial costs of starting up a CAD system, with many trial-and-error expenses and high training budgets added to hardware and software expenditures, are not typical of the long-term experience. However, there will be a continuing need to train people, explore new working strategies, and choose and implement new software. Some of these will be offset by the growing familiarity with CAD in the design profession: soon all training will be a matter of upgrading skills, not starting from scratch.

It is particularly difficult, perhaps impossible, to measure the value of improved design quality. Factors such as accuracy, drawing clarity, and increased thoroughness are intangibles, yet they are among the most important reasons to use computers. They must be evaluated subjectively, but they *must* be evaluated in order to know how effectively your CAD system is being utilized and how it can be improved.

Don't draw conclusions too soon. It takes a long time to reach a point at which the system functions at a

high level of productivity. If at first you are producing no more work than you produced manually, don't panic. Keep an eye on productivity, but don't forget to consider improvements in quality, and, as you develop drawing libraries and office conventions, consider the work that may be saved on subsequent projects. Remember that the greatest gains in productivity are to be found in modifying and developing a drawing, not in the initial drawing stages.

It is common to find the same amount of time being spent on computer-aided design as manual design, only with a higher percentage being spent on design than on drawing. Is this a problem or a benefit? This question is intrinsic to the philosophy of a firm; in fact, it is intrinsic to the future of the architecture profession.

Efficiency

As design and drawing can be done more efficiently, there is a tendency for architects to lower their fees in order to obtain work. This may have a serious impact on the type and quality of work that results. A competitive frenzy to outbid other architects (and nonarchitects) for work may drive fees down to the point at which there is little choice but to rubber-stamp repetitive designs and details across the landscape. If fees drop to the level of the minimum labor costs required to produce a building that will stand up, the profession could be transformed into an electronic assembly line.

On the other hand, if architectural fees remain fairly steady, then productivity increases will encourage more thorough design and production. Most architects know that design work tends to expand to fill the available time (and then some). There are great benefits to spending more time on design, and clients must be made to understand this. Fortunately, it is not difficult, as we will see later in this chapter.

The methods for billing for computer use vary from office to office. Some attach an hourly fee to computer time, while others raise their overhead factor in billing clients, either for all work or, in some cases, for work done by computer users. As computer use becomes more widespread, it is becoming more convenient to include computer costs as general overhead. There are, however, two exceptions: first, although you can't usually bill clients for training time, you should set up a formula for billing a fair percentage of training time spent on project work. It is often acceptable to split a labor rate between two budgets, one for training and the other for project work, if the criteria is clear and records are kept carefully. Second, when a client requests extra services based on the

capabilities of the computer, such as plots of multiple three-dimensional views, these expenses are generally billed separately under the terms of the architectural contract.

Most design work is done with pressing deadlines, and computers will not alter this fact. Yet it's good to remember an axiom from a well-known architect, and apply it when you can: "Architecture should not be done in a hurry."



No one kind of office organization is most appropriate for using computer-aided design: Virtually any setup can accommodate new tools if they are chosen and implemented wisely. Design firms are organized in many different ways, but there are roles that are common to most firms, large and small. Likewise, there are roles that must be filled to effectively use a computer-aided design system.

OFFICE GEOGRAPHY

Design firms tend to be organized either vertically, in which a team works on a project from start to finish, or horizontally, meaning a staff of specialists passes a project from department to department. In theory, CAD can be used equally well within either structure, especially if everyone has access to a CAD workstation. In practice, this is not always so.

Horizontally organized firms generally have a distinct drafting or working drawing department, and this is usually the first group to use a CAD system. Unfortunately, it is also often the last. In a firm with a drafting department, working drawings are often considered distinct from the design process, and designers may avoid the production of working drawings completely. Thus, the potential for using CAD as a design tool tends to be neglected: when designers use it, they tend to ask the drafting (or graphics) department to produce a set of presentation drawings. Thus, much effort is duplicated, and designers fail to learn to use a valuable tool.

There are three reasons for this situation.

- There is often an attitude in large firms that drawing is for drafters, only.
- CAD systems were once too difficult for designers to learn without becoming full-time drafters.

- CAD systems have been physically isolated in a drafting department, often isolated from the design department.

The first two factors are changing quickly. Designers are quick to see that CAD, modeling in particular, are useful design tools, and software has become far simpler to learn. There is still, however, a tendency to segregate computers into isolated areas, removing them from the design process. This not only makes it difficult for a designer to work on the system, it makes it inconvenient to even talk with the person who is drawing. If separate departments are maintained, it is crucial that designers have easy access to computers for design purposes. Furthermore, it is equally important that design and drafting departments use similar software and drawing conventions. There is tremendous labor saving potential in being able to swap disks back and forth between departments, but there is also potential for confusion and time-wasting if they are exchanged in dissimilar formats, such as different layer schemes.

These are problems that vertically organized offices should not have to face—yet often they do. Small firms that have worked in teams for years have been known to create a “CAD Department” because they assume that computer-aided drafting is a specialized skill and that computer-aided *design* is not worth the effort. The introduction of specialization into a team-oriented design process can cause havoc at worst and will slow down the design process, at best. Cooperative design requires a familiarity with the project on the part of all members of the team. Assigning a CAD specialist who is not familiar with a project to draw a designer's work requires extra explanation and introduces new opportunities for error. There is, again, a tendency to isolate drafting computers from the main-

stream of the office design work, which discourages others from learning to use the CAD tools (Figure 8-1).

If there is a single set of rules for office geography, it should be: *keep people near their tools, and don't isolate people from each other.* Ultimately, everyone in a design firm should have direct access to a computer. At that point, the matter becomes an issue of office design, which architects should be well equipped to handle.

ROLES AND HIERARCHIES

In the early days of computer-aided drafting, when tremendous investments were required to train people, the role of “CAD Operator” was created. The specialists that filled this role often had little architectural training, and those who did rarely had the opportunity to use it. Although the job had a certain kind of prestige, it was also considered a dead-end. Could a CAD operator ever hope to become a project architect?

Fortunately, the role of CAD operator is no longer necessary, since learning to use CAD is no longer a career in itself. Nevertheless, the role persists. There was a time when it was easier to teach architecture to a computer operator than it was to teach computers to an architect; now it is unnecessary to train nonarchitects to work with architects. The persistence of the role of CAD operator has an even more negative impact. The idea that using a computer can lead to a dead-end job can thoroughly sabotage the introduction of a CAD system into a design office.

Shift work is another trap. When CAD systems cost hundreds of thousands of dollars, firms had to use the equipment two or three shifts a day in order to pay for it. Not only does this isolate and demoralize those who work on the night shift, it also makes projects very difficult to coordinate. Since computers are expensive, even now, it is sometimes tempting to keep them operating as much as possible. While this may be helpful for training people after hours, it can be very disruptive if an office is split into two shifts. A common compromise is to overlap shifts, say 7AM to 3PM and 12PM to 8PM.

It is also possible to simply overemphasize computer-aided design. For example, when new employees begin work, their orientation should not be solely “meet the computer”; it is still important to introduce people and explain office customs. Likewise, if too much attention is paid to the progress of an individual or a project, an unnecessary amount of pressure can develop, and people start to worry that the system's failures will be attributed to them, personally. This is

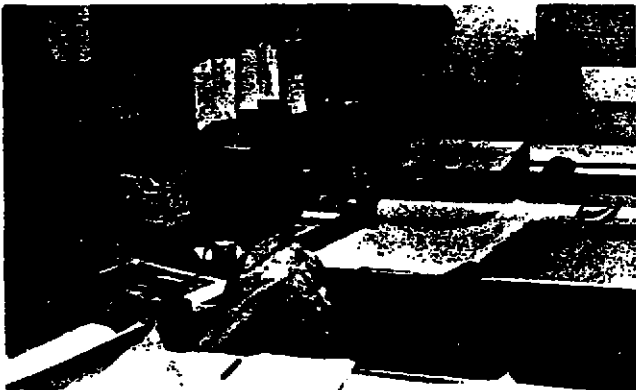
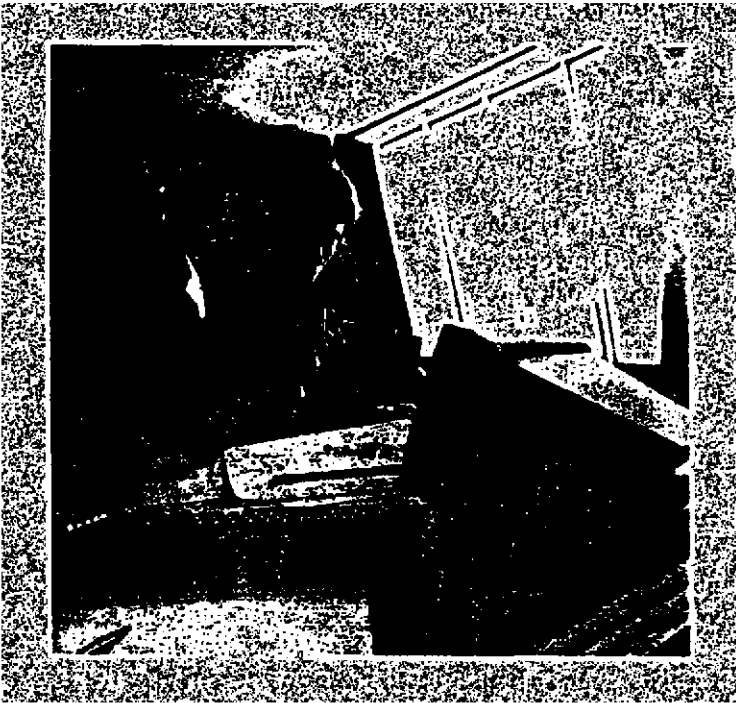


FIGURE 8-1 A computer at every desk. Neeley/Lofrano Inc, Architects, San Francisco.



particularly true when instant productivity increases are expected. Often a manager will forget that real increases in efficiency not only require much practice, but that they only show up after much ground breaking has been done, such as the creation of base drawings or drawing libraries,

Managing the System

Each office has its own ways of organizing drafters, designers, and managers, and there is no reason why this system should change significantly as a CAD system is introduced. It may be, however, that the responsibilities at each level will change. For example, a project architect may be more concerned with graphic standards if his or her drawings will be converted directly to presentation drawings or working drawings; a drafter may become more responsible for making material choices when using drawing libraries with built-in attributes. These kinds of changes should be discussed among all concerned, because they can lead to mix-ups and bad feelings if they are not understood.

There is one new role that arises with CAD in all but the smallest practices. A CAD manager is someone who is responsible for planning and evaluating the CAD system, as well as for overseeing its day-to-day use. This person may be an experienced drafter, a management-level architect, or someone in between. There are two criteria for the role: First, this person should be interested in the nuts-and-bolts workings of the software and hardware, though not necessarily an

expert. Second, he or she should be intimately familiar with the procedures and requirements for taking an architectural design through whatever phases the system will be used for.

The CAD manager fills a number of roles, such as

- Recommending hardware and software choices,
- Organizing training schedules,
- Conducting training or introductions,
- Customizing the CAD system to the needs of the firm,
- Setting up working schedules and coordinating machine access,
- Suggesting and implementing drawing conventions,
- And, most importantly, seeing that projects move from phase to phase in a logical, efficient manner.

Essentially, the manager is responsible for seeing that the system is used effectively.

In a large firm, a CAD manager's job is full-time, since many workstations and projects require a great deal of attention. In a small firm, however, it is possible for an architect or drafter to fill the role adequately while participating in his or her usual projects. This need for a CAD manager may diminish over time, as practices are established and project managers become more capable of guiding a project through the nuances of computer-aided design, and as each user learns how to customize the system without violating office standards. Thus, in a midsized office, a job that may require a full-time manager initially may allow this person to return to project work after six months or a year.

SETUP AND BACKUP

In Chapter 4 we looked at a number of issues that must be addressed before drawing, such as layer schemes, drawing libraries, and software customization. Many of these are best handled through the implementation of office conventions. Setting up these standards must begin before the first project is started, though they may evolve indefinitely. They may be developed by an individual or by users' suggestions, but they should be coordinated by the CAD manager.

Staying Current

The most crucial single issue in operating a computer-aided design system is file management and backup. It

is vitally important that everyone work with up-to-date copies of a drawing; since it's so easy to save one's copy on a hard disk at the end of the day, it's tempting to continue working on it the next day, even though someone else may have revised the original on another computer in the meantime. This is similar to the need to keep current sets of drawing prints in circulation, except that it is not as obvious when the original is being changed: there is no mylar original sitting on someone's desk. The techniques for communication will vary greatly depending on the number of people involved and the CAD system configuration, but in any circumstances, communication is crucial.

The most common solution to this dilemma requires a centralized location for the storage of a set of electronic master drawings. The container can be a box of master floppy disks that are updated at the end of each day, then copied onto each machine the following day, or a single, large capacity hard disk. In the latter case, drawings can be copied to the hard disk from floppy disks, or via a computer network, through which files may be passed back and forth as required. None of these procedures are simple to do, every day, without exception, but the hazard posed by mix-ups requires a central storage any time more than one person is working on a project.

When different people work on the same drawing simultaneously on different computers, they need to coordinate their work in order to be able to merge the new versions. If they are working on different areas or layers of a drawing, adding one to another is not particularly difficult with most software. However, if they are working on the same part of a drawing, combining them can be difficult. In this case, it's best for one or both to work on an alternative set of layers, to keep their work separate, just as if they were using tracing paper. Several different alternatives can be stored in a master drawing and reviewed later.

Alternatively, you may divide a project into several drawing files, by area or by groups of layers. Each piece should be kept on a single master floppy disk, and only the person who borrows a master disk may work on that area or layer set. This method is particularly useful with a very large project that must be subdivided into manageable-sized files anyway.

Staying Secure

One of the scariest aspects of learning to use a computer is the fear that a single mistake will cause a drawing to be "lost." Most programs include safeguards and warnings against taking the few actions that can really harm your work, but you are doubly secure if you know you have a copy of your work on disk. Some software

will always maintain an up-to-the-minute copy of your work on disk while others require that you save a copy at intervals. If a power outage can cause you to lose your drawing, then it is crucial that you make backup copies frequently, say, every hour or so. Since a hard disk malfunction can destroy data, it is also important to copy your work onto a backup disk (or tape, if you use a tape backup system) daily. If you are confident that your drawings are backed up, fears of losing your work should disappear.

Your backup disks or tapes can also help you to maintain a record of the evolution of a project. Sometimes you need to refer to an old version of a design: if you have a daily or weekly record of your project, you can reload an old version. If you want, you can extract parts of an old drawing and place them into the current version.

Institutions that deal with complex, irreplaceable records, such as banks, often maintain dozens of extra copies of their computer records, located at secure, scattered locations. Architectural drawings are no less valuable to the practice of architecture, but firms often keep entire projects on a single disk. Usually this is a matter of carelessness or laziness, rather than intent: a procedure for copying and storing backup disks may be planned, yet neglected, because it's "too much trouble." Obviously, losing a project in a computer malfunction or a fire is even more trouble. In addition to making sure that drawings are copied and stored securely every day, it is wise to maintain weekly backups outside the office, even if only at someone's house.



Strictly speaking, computer-aided design includes graphics and integrated database capabilities, but design firms are also aided by a number of other computer applications, most of which relate directly to design.

PROCESSING WORDS, RECORDS, AND NUMBERS

One of the first areas of architectural practice to be computerized was writing and editing; since minicomputers and the first microcomputers were particularly good at these tasks. Although these same machines could also perform number-crunching miracles, it is only recently that architects have begun to use this

capability. These are now fairly commonplace computer applications, so we will only look at them briefly in passing.

Word Processing and Specifications

Architects, despite the visual orientation of their profession, can produce large quantities of writing. It's not uncommon for an architect to spend part of every day writing memos, letters, proposals, reports, meeting notes, or project records, usually scribbled in haste and passed on to a secretary to type. Though time-honored, this technique is at best inefficient, since it requires everything to be written twice. A good typist can use a PC-based word-processing program to turn out a rough draft and leave it to be edited by a secre-

tary; however, a slow typist may find it a waste of time that might be better spent on other work. The decision is largely personal, but it makes sense to have computers and word-processing software available to anyone who writes.

When appearance is crucial, the software heavy artillery may be called for. Proposals and public relations brochures are often produced in-house and often require a combination of text and graphics. Desktop publishing software can be used to design page layouts, mix type fonts, and add illustrations to text. In combination with a laser printer, you can produce material of near-typeset quality. Ideally, you should be able to transfer drawings directly from your CAD system into a brochure or proposal, and using image-capture software (see Chapter 2) enables you to add and modify photographs. Ultimately, you can virtually eliminate cutting and pasting. Better still, you can eliminate the need for outside typesetting, with its attendant costs and deadlines. Since a page can be reprinted in seconds, the firm brochure can be revised any time a new project, drawing, or photo is added.

Construction specifications are perhaps the most demanding piece of writing that architects do. Even though standard specification forms have been used for years, specifications are nevertheless often written, or more often *adapted*, by specialist spec-writers. Specs tend to be complex descriptions of materials and construction methods, filled with terms that must be both comprehensible and legally valid, so this specialization is not without reason.

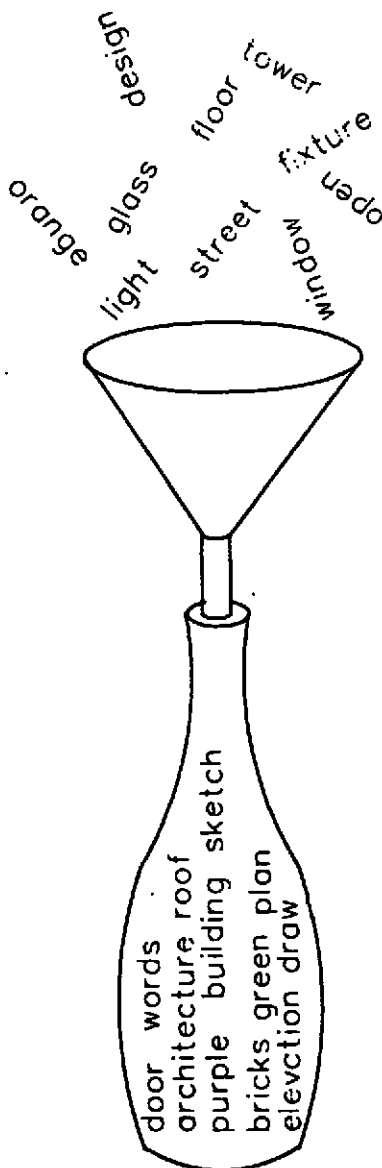


FIGURE 8-2 Although cost estimating, schedule-processing, or specification writing can generally be done on the same computer used for graphics, sometimes you may want to work on these as you draw. In lieu of a multitasking, windowing computer, it's not a bad idea to have a portable computer around the office. Neeley/Lofrano Inc., Architects, San Francisco.

Specification-writing is particularly well suited to computerized word processing, since specs often change very little from one job to another. Often whole sections can be reproduced with few or no changes. For this reason, "canned" spec packages like the AIA's Masterspec are invaluable. From a disk-based original, you can choose, then modify whatever sections are appropriate to the particular job you are doing. Very little writing or typing is required. These electronic originals can also be referenced to drawing libraries and attribute-linked databases, so that when a particular item is placed in a drawing, the appropriate specification is noted for later inclusion in the construction documents.

Getting Organized

In a design office, record keeping can be a particularly difficult chore, since many different kinds of records must be stored in an accessible manner. Usually every project has its own set of files, within which are kept correspondence, memos, meeting notes, transmittals, field notes, change orders, and so on. Each of these records covers one or more subjects, such as program requirements, site drainage, or doorknobs. Cross-filing, or placing copies or references in several places,

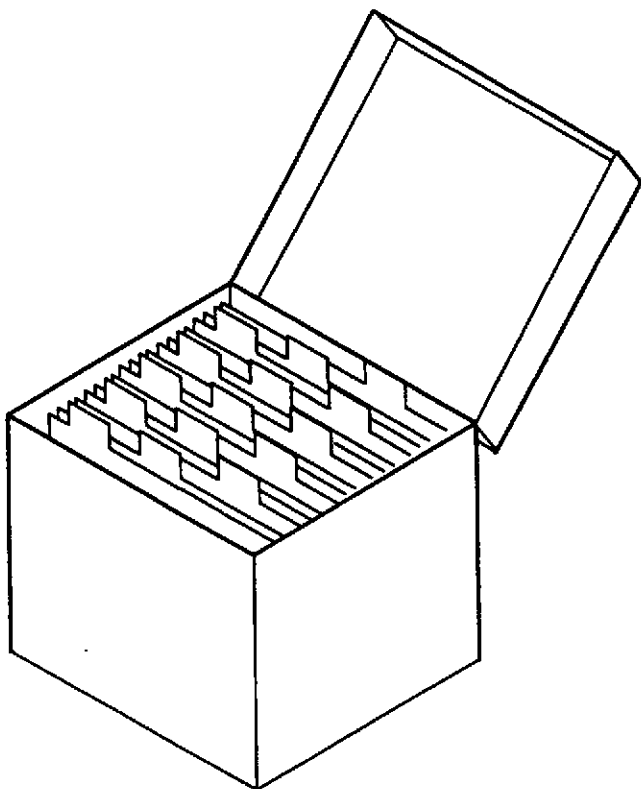
is often required. Keeping a complex filing system organized, current, and accessible can be a difficult task.

If, instead, these records are cross referenced by a database program, they can be kept on disk and located by subject, date, source, or other criteria. Each record is like a 3×5 card with many index tabs with which it can be pulled out. Some items, such as correspondence, may be separate letters in a file that are referred to by a "3 $\times$ 5 card" in the database, listing the topic, source, recipient and date. Change orders, on the other hand, may be typed as entries into a database form, then printed out as a final document. The full text remains in the database, subject to recall via its date, subject, destination, or number. This system may also be used to automatically tabulate the construction costs represented by change orders, perhaps divided up by sub-contractors.

Number Crunching

Spreadsheet programs were largely responsible for the initial popularity of the personal computer and have since been adapted to many different uses. As we saw in Chapter 7, spreadsheets can be used for estimating construction costs throughout a project; they can also be used for tracking and estimating internal project costs. In addition, office management and accounting require very repetitive budgeting and record keeping, none of which makes sense to do by hand when there is a computer available. Specialized accounting software is available to handle much of this work, though a small firm can often do well with a good spreadsheet program. Like graphics software, spreadsheets can be customized with add-on packages. Called *templates*, these are designed to handle specific applications like accounting or project budgeting.

A project manager needs to know, accurately, how much money has been spent on a design project and how much is left. From this information, it is possible to plan which individuals will work on a project and how much time they can spend on it. Many of these calculations can be performed with a spreadsheet alone, but they can be kept up to date most effectively if the spreadsheet is linked to the office payroll and billing records. Templates and accounting programs are available that are oriented specifically toward architectural and engineering firms; like CAD software, they can be very helpful if they fit the way you work. It is important, however, to be sure that these programs can provide the specific information that you need to manage both a project and your office accounts. Software that attempts to do both tasks but does one badly will be a liability.



PROJECT MANAGEMENT

Since architectural project schedules are dependent on a variety of factors that are difficult to anticipate, they are notoriously difficult to plan and maintain. Design and drawing time are hard to estimate, consultants are sometimes unreliable, and unexpected delays are often imposed by clients, financial sources, and public agencies. Large and small firms alike face persistent scheduling problems that result from having to adjust to these uncertainties.

Computer-based project management (PM) was originally developed for very large construction, industrial, and aerospace projects. However, microcom-

puter PM systems have proved to be useful for much smaller applications, including the scheduling of architectural design work. Like CAD, it takes some time to learn and implement project management software, but once you begin using it, you can predict project schedules and personnel schedules more accurately and with much less effort.

Project management software is most effective with large projects that require the coordination of many *resources* (people and organizations) and many *tasks*. As you might expect, small projects are easier to set up, so there is reason to consider using it on either large or small jobs. It can also be limited to managing schedules and personnel *inside* a firm, or it can be

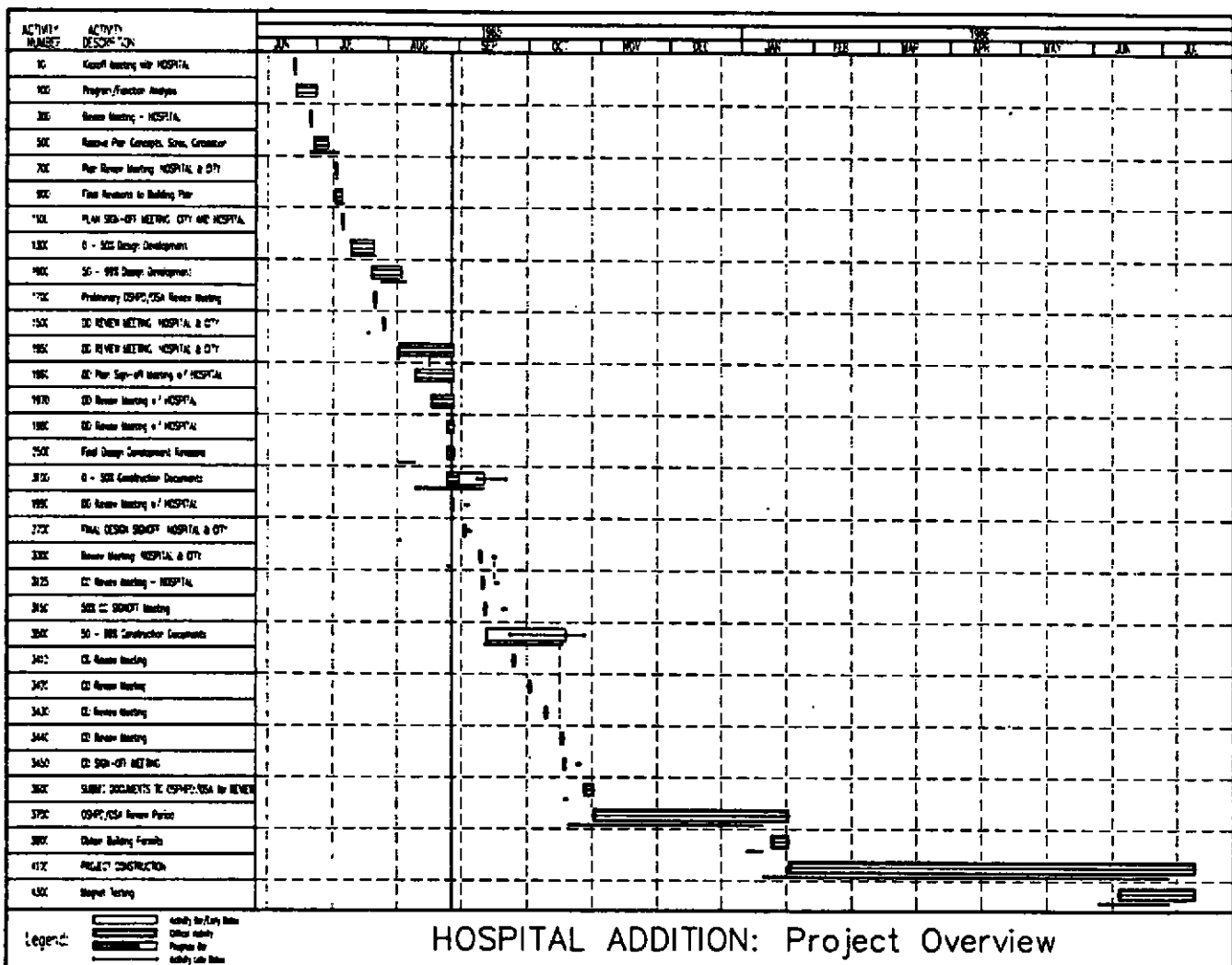


FIGURE 8-3 This bar chart illustrates a project schedule that was developed in a few hours when planning the project, then kept up-to-date as the project progressed. Whenever a task was completed early or a meeting postponed, the schedule was updated and a new chart

produced. This figure and 8-4 are externally oriented schedules; as opposed to internal job-management schedules, which are also useful. Both were produced using Primavera project management software. P. Bernstein, Kaplan/McLaughlin/Diaz, Architects.

applied just to scheduling *external* events such as meetings and submission deadlines.

In essence, project management software lets you list the tasks that make up a project, place them in order, estimate the minimum and maximum times for each, and assign resources according to available time and budget. You can also use the Critical Path Method (CPM) to specify which tasks are dependent upon the completion of others, and you can assign a *float* factor that determines the amount of leeway available in starting or completing a task. Once you have outlined these factors, you can view your project as a list of tasks or resources, as a *bar chart* (Figure 8-3) that illustrates when activities occur and which overlap, or as a *network* (Figure 8-4) that shows the critical path. The advantage to doing this on the computer is that any

time your schedule changes or a new task is added, the software will recalculate the entire schedule, enabling you to see the impact that changes will have on later tasks and completion dates. Another particularly useful function is called *resource leveling*: if you specify a maximum number of people that can work on a project or task at once, the software will calculate how much longer the task will take, then recalculate the schedule.

Project management occurs in two stages, *planning* and *monitoring*. Using traditional project management techniques, careful analysis of schedules, budgets, and staff use usually takes place in the planning stage of a project, when fees are being negotiated and personnel assigned. However, once a project begins, it is very difficult to manually update a

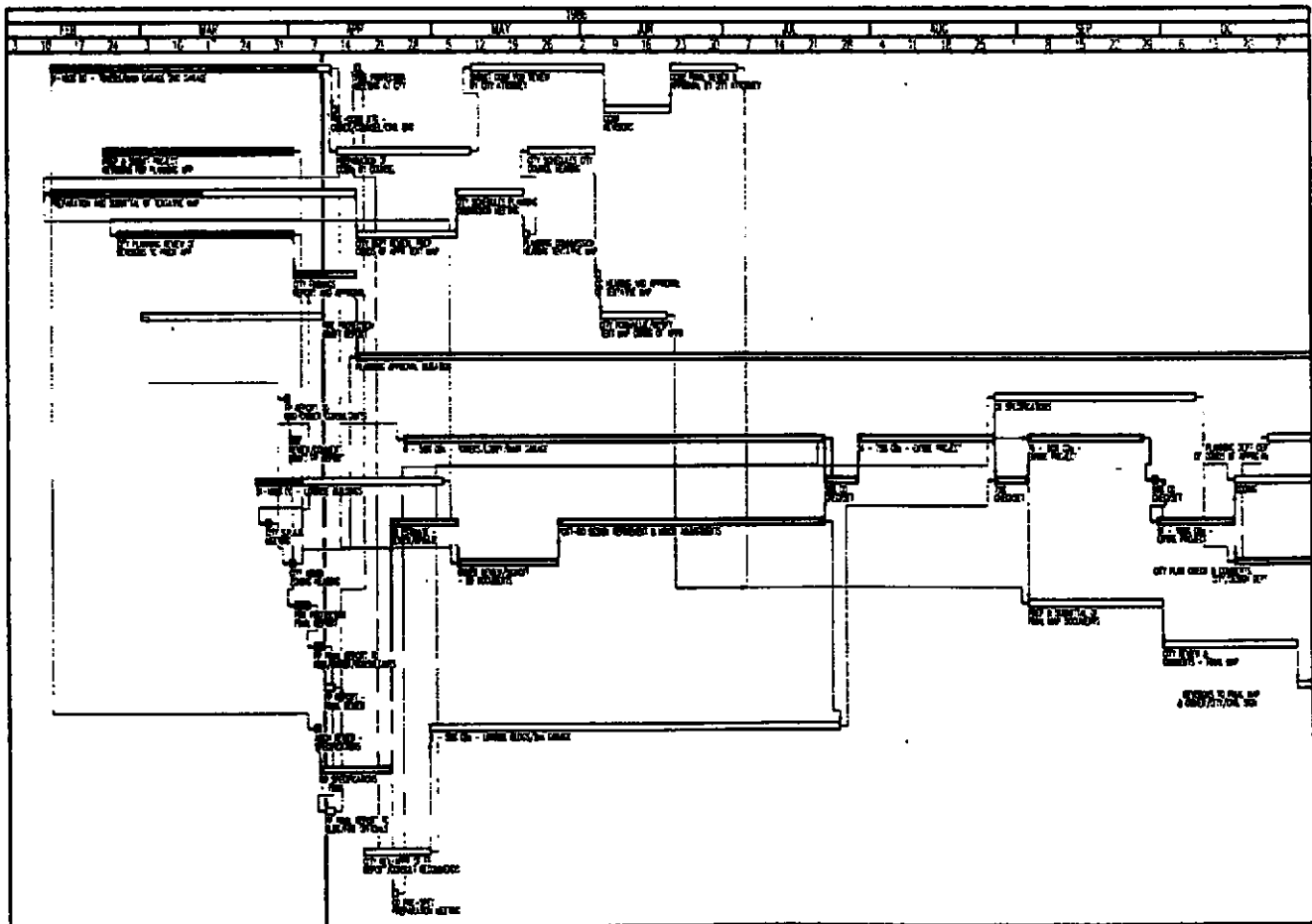


FIGURE 8-4 A network diagram was developed to help guide a large urban housing project through the design development and construction documents phases. The network illustrates both scheduling and sequencing, including the highlighted critical activities, upon which other

activities depend. With some practice, one can read the arrowed sequences as if the network was a project road map. P. Bernstein, Kaplan/McLaughlin/Diaz, Architects.

schedule every time there is a delay or a change in the scope of the work. Management tends to become ad-hoc, and the monitoring of costs and schedules becomes less precise.

Using the computer, the planning stage can be used to set up goals for scheduling and resource allocation that are based on previous experience: each project management network can be based on a standardized model that is adapted to new projects by adding and subtracting tasks and resources. The creation of a fully detailed network is a laborious undertaking, prone to errors of omission; working from a standard model that reflects your office routines can help to begin a project easily and accurately. The model can help you avoid reinventing the wheel each time you begin a job.

Once a project begins, PM software can be used to monitor progress in relation to the targets you have established and measure the impact of changes in deadlines and resource availability. Monitoring with the computer is far easier than manual monitoring, since a project manager can periodically enter evaluations of project progress by simply noting the dates that certain milestones are passed and keeping track of the amount of time that is spent on each task. Some PM software permits time accounting to be integrated with office time card/payroll systems, so that reporting can be done automatically.

The graphic capabilities of computer-aided project management provide a potent dramatization of the implications of scheduling decisions. Changes to a schedule tend to have a rippling effect throughout the remainder of a project: when a client misses an approval deadline, there is a delay months hence that may cause another deadline to be missed, unless more people are assigned to the job. The resource leveling capability illustrates the tendency of tasks to act like balloons: if you shorten the time (compress the horizontal dimension), you must add people or work overtime (the vertical dimension expands), and vice versa.

Not all project management software is appropriate to architecture. The design professions commonly have activities that vary, day by day, in personnel availability, task sequences, and priorities, so software must be very flexible. Since it often must be used by people who are trained as architects and not as project management specialists, it is important that it be relatively easy to learn and convenient to use in the midst of a job. PM software is usually not appropriate to projects that can not be mapped out fairly clearly in advance or to unique jobs that cannot cover the costs of planning a whole new PM network. However, if you can develop standard models for project organization,

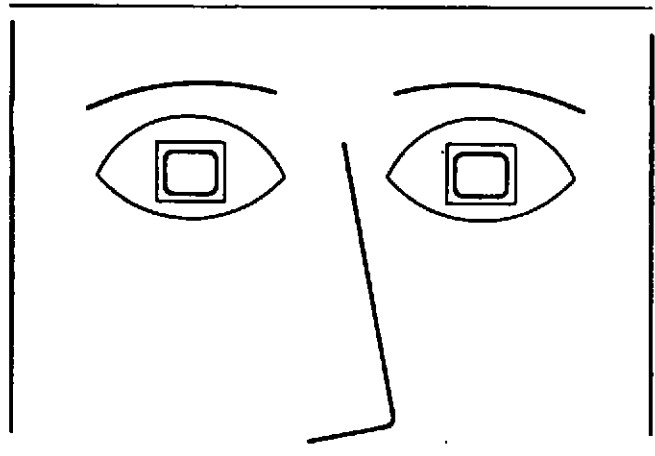
computer-aided project management can be a fruitful tool for getting and staying organized.

WORKING AMONG THE MACHINES

As efficiency rises in the computer-aided office, does job satisfaction follow? This question, spoken or unspoken, weighs heavily over the decision to automate a design firm.

The question is often raised in connection with the physical qualities of computers. After all, few people really want to spend forty hours a week staring at a TV screen: it's tiring. It's hard on your eyes and hard on your backside. (Of course, so is working at a drafting board. A mobile, high resolution monitor with no glare can be surprisingly comfortable for reasonable periods of time.) It's important to realize that breaks are necessary when you use a video screen for drawing (or writing or calculating, for that matter) and that many people can not work effectively at a video screen for more than about six hours a day. This is not, however, inconsistent with the way most firms operate: individuals often have more than one task pending at any given time, and people often take turns working on drawings. With CAD, it's a good idea to run plots and check the current work on paper frequently anyway.

Lurking behind the issue of job satisfaction is often a concern about increased pressure to produce and a dehumanization of the workplace. Since computers have been used to turn more than one kind of workplace into an electronic sweatshop, this is a legitimate concern. However, it is not something that is intrinsic to the tool: sweatshops are the product of management that values speed and profit over quality of work. Computers can be used toward this end very effectively, if



managers choose to use them so. Computers do not cause this problem nor will they solve it. They can, however, make overwork even less palatable. In the interest of mental health and good eyesight, issues of working hours and the physical working environment need to be carefully addressed.



Architects design a small portion of all the buildings that are built, well under 10% by many estimates. Clearly there is room for professional designers to extend their services into new markets. We have seen that computers are automating some design tasks, perhaps bringing new kinds of work to some designers, taking work away from others. We have also seen that there is a risk of competitive fee cutting. Why should we expect a bigger cut of the pie?

MARKETING ARCHITECTURE

Marketing plays a key role in attracting architectural commissions. Architectural services can be marketed many ways, from personal contact to slick advertisements. Computers are having an impact on the way services are marketed, to be sure, but the widening range of services that designers can provide is also affecting *what* architects are offering.

Your design process itself can be a significant factor in obtaining commissions. It is important to show potential clients the efficiency and accuracy you can provide them. A client has reason to be concerned that a project will pass smoothly from phase to phase and be communicated clearly, at a carefully controlled cost, to the builder. As builders become familiar with computer-produced designs, they are beginning to expect better quality, trade-specific drawings and specifications; knowledgeable clients are concerned with this. Many clients are also stirred by increased opportunities for input into the process, especially interactive three-dimensional exploration of a proposed building.

Going beyond the traditional architectural practice, firms can offer some of the services outlined in Chapter 7—construction planning and management, facility management, and so on. Architecture is a wide-ranging profession, and it may be becoming more so. It

can be argued that a designer's involvement in the building and urban design processes has been limited more by the traditional roles and legal structures of the industry than by logic: there may be valid reasons for architects to participate much more closely in planning, construction, and building management. If so, the graphic and information-handling capabilities of computers may prove to be the tool that makes this possible. In the long run, the most significant effect of computer-aided design may be expansion of the narrow base on which architects currently focus their services.

A BIGGER PIE

The specters of off-the-shelf, standardized buildings and fully automated expert systems are worrisome to many architects. Since it is possible to create a somewhat customized building with even a relatively simple parametric drawing program and a master design, these fears are not unfounded. Surely these kinds of programs will have an impact on the profession.

If architects are to turn increased efficiency to their advantage, they may have to make inroads into the 90% of construction that they aren't involved in. Much of this work is built on relatively low budgets, or is built according to standardized designs with little modification. This includes mass-produced housing, as well as large amounts of commercial and industrial construction. For the most part, it is lacking in the quality that architects are in business to provide—custom design.

As we have seen, drawing libraries and expert systems can reduce many of the time-consuming aspects of architectural work. By encouraging custom assembly of standard elements, they can lower production costs and, potentially, make lower-budget custom work more attractive to a firm. It will not be easy for architects to hold fees for more complex work at current levels while pursuing lower fee work, and it seems likely that individual firms will tend to specialize more and pursue work at one level or another. Nevertheless, if lower-budget work is more feasible, it is largely a matter of convincing developers, builders, and home-buyers that architects provide a service that is worth buying. If architecture is to continue to be a valuable service, architects must continue to offer the synthesis of site design, programmatic problem solving and building system design that humans can do better than a computer can do.

As the printing press replaced the scribal craft with typography, our *means* are changing. Computer-aided design opens new doors for designers, much as

typography liberated writing and publishing. Our roles as architects are changing, and our design strategies will continue to evolve as our tools continue to change.

Any tool may be used well or badly, and computer-

aided design is no exception. Architecture is and will continue to be based on the skill and intentions of architects. Computers can make both good and bad design easier to produce: perhaps this makes design skill more crucial than ever.

Reading 4

Solid Modeling and Volumetric Composition in Architecture

William Mitchell

Design Computing
September 1988

Solid Modeling and Volumetric Composition in Architecture

William J. Mitchell

Graduate School of Design, Harvard University, Cambridge, MA 02138

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ARCHITECTURAL COMPOSITION

A building may be described as a set of closed *volumes* arranged in space, as a set of *surfaces* bounding these volumes, as a set of *lines* bounding the surfaces, or as a set of *points* defining the ends of the lines. A description purely in terms of points usually contains too little geometric information to be of much use to an architect, but architectural composition has often been approached as a matter of arranging and relating lines; the great Italian Renaissance architect and theorist L. B. Alberti, for example, defined design as "a right and exact adapting and joining together the lines and angles which compose and form the face of the building." This type of design can be supported by a two-dimensional drafting system, with operations for manipulating vectors, arcs, and perhaps other types of plane curves, or by a three-dimensional wire-frame modeling system.

Other architects have preferred to regard composition as the arrangement of surfaces in light; Le Corbusier developed this view in *Vers une Architecture*, for example. Surface modeling software can be used to support this type of design, and effects of shading and shadow can be studied very effectively using a raster display. (Architects of earlier generations used graded watercolor wash for the same purpose.)

Yet others have approached architecture as volumetric composition. The French Beaux Arts theorist Julien Guadet, for instance, defined "elements of composition" as the major enclosed volumes (rooms, etc.) of a building, and "elements of construction" as solid components such as columns, beams, and walls. A designer, according to Guadet, arranged those geometric elements in space. Composition conceived in this way can be supported by solid modeling software.

VOCABULARIES OF PRIMITIVE SOLIDS

The foundation of any solid modeling system is a vocabulary of primitive solids which form the building blocks out of which compositions are constructed. An architect needs a vocabulary of primitive

solids that is extensive enough to establish a sufficiently rich and interesting universe of compositions for exploration, and that makes sense in terms of construction technology and other relevant practical concerns.

A very simple architectural solid modeler might take the rectangular parallelepiped, with length, width and height as variables, as the only vocabulary element. This would allow the designer to work with cubes, boxes, square columns, rectangular beams, flat rectangular slabs, and so on (see Figure 1).

The rectangular parallelepiped might be generalized to the convex prism. Many such prisms are of architectural interest: the wedge, for ramps, battered walls, and shed roofs, as shown in Figure 2; the isosceles triangular prism for gable roofs, as seen in Figure 3; and the regular polygonal prisms for columns (see Figure 4).

Lines projected through the vertices of convex polygons might, instead of being parallel as in prisms, converge to a point. This adds pyramidal forms to the architect's repertoire.

Renaissance architects were fascinated by the regular polyhedra: tetrahedron, cube, and so on (see Figure 5). These, in varying sizes, might also be featured in an architectural vocabulary.

All the types of solids considered so far have plane, polygonal surfaces which meet at straight lines. A vocabulary can be extended to admit curved surfaces in the simplest possible way, to include the cylinder, with radius and height as variables. Now rods, cylindrical columns, drums and disks become possible (see Figure 6). Not only straight lines, but also arcs of circles can appear in compositions.

As the pyramid is to the prism, the cone is to the cylinder. Conical forms appear in architecture point-up (roofs and steeples), point-down (amphitheaters), and occasionally sideways (see Figure 7).

A third three-dimensional derivative of the circle is the sphere (see Figure 8). Complete small spheres sometimes appear as decorative elements, but larger spheres (with a few famous French exceptions from around the time of the Revolution) usually only appear

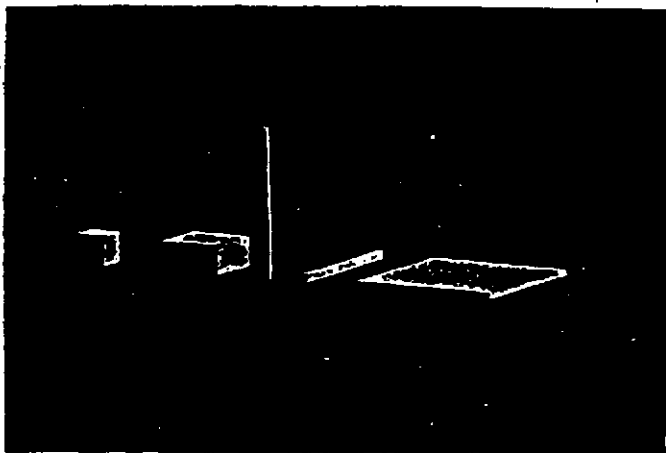


Figure 1. Variants of the rectangular parallelepiped: cube, box, square column, rectangular beam, flat rectangular slab.

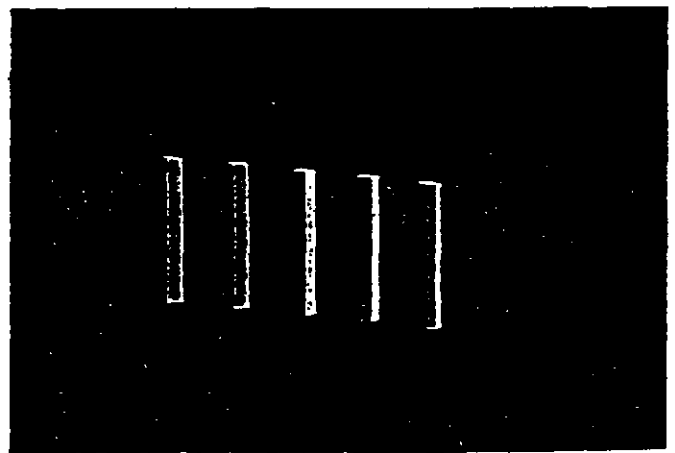


Figure 4. Polygonal prism columns.

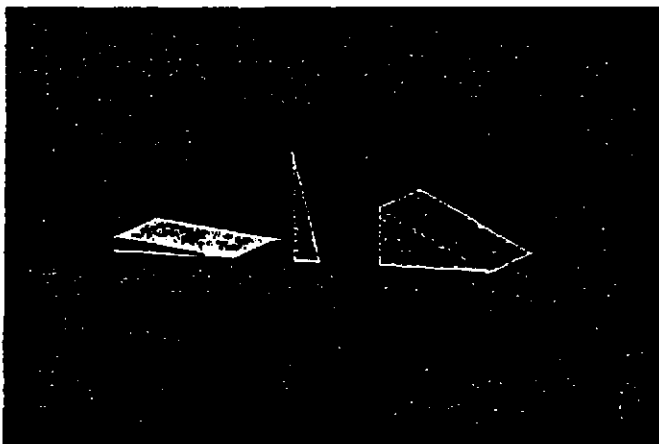


Figure 2. Variants of the wedge: ramp, battered wall, shed roof.

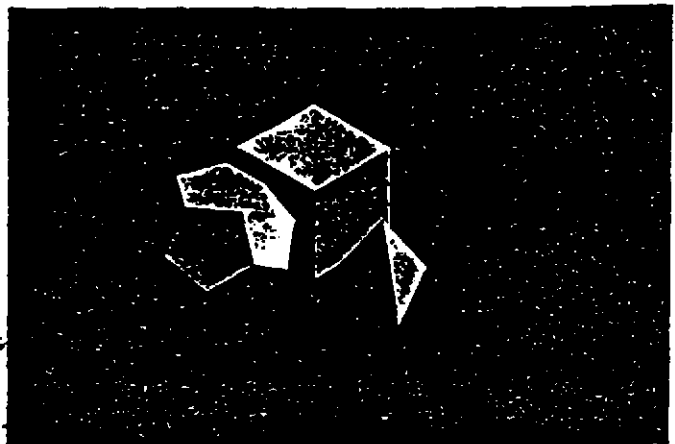


Figure 5. Regular polyhedra.

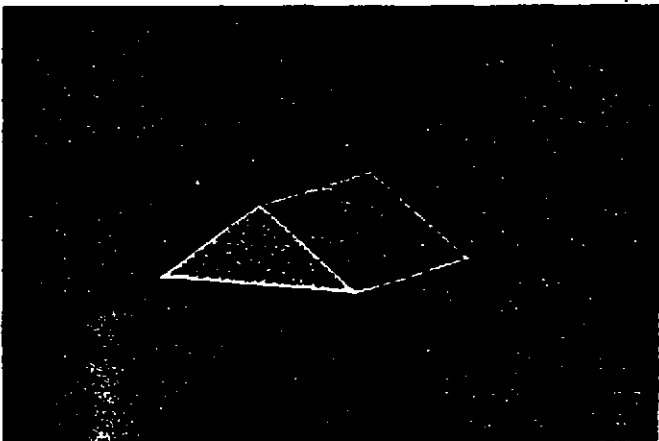


Figure 3. Gable roof.

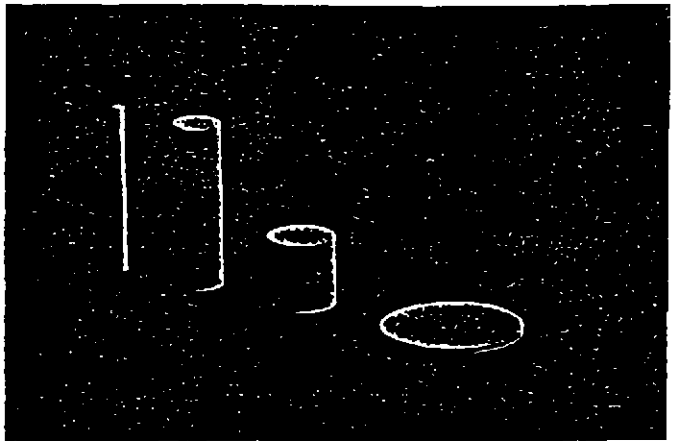
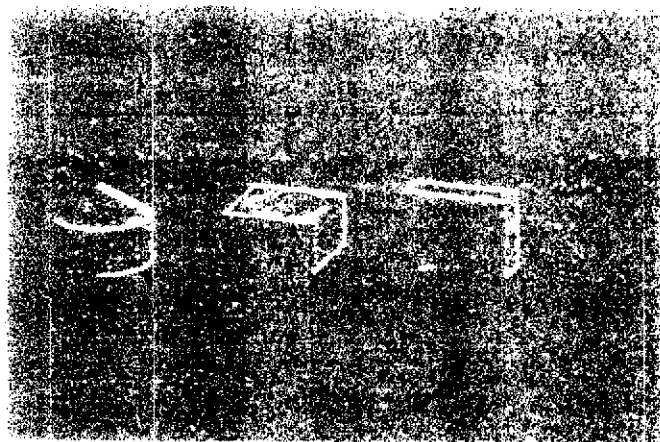
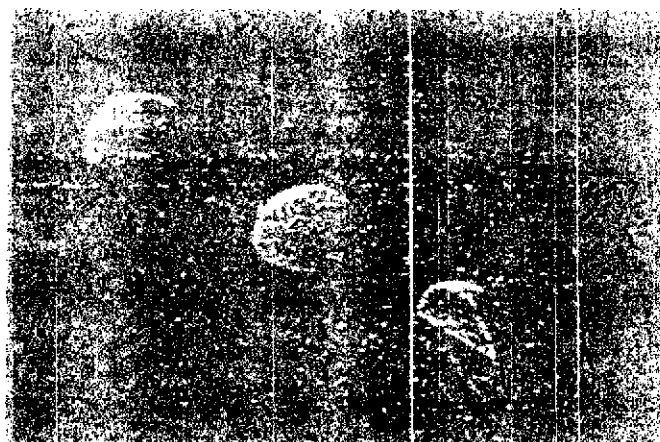


Figure 6. Variants of the cylinder: rod, cylindrical column, drum, disk.

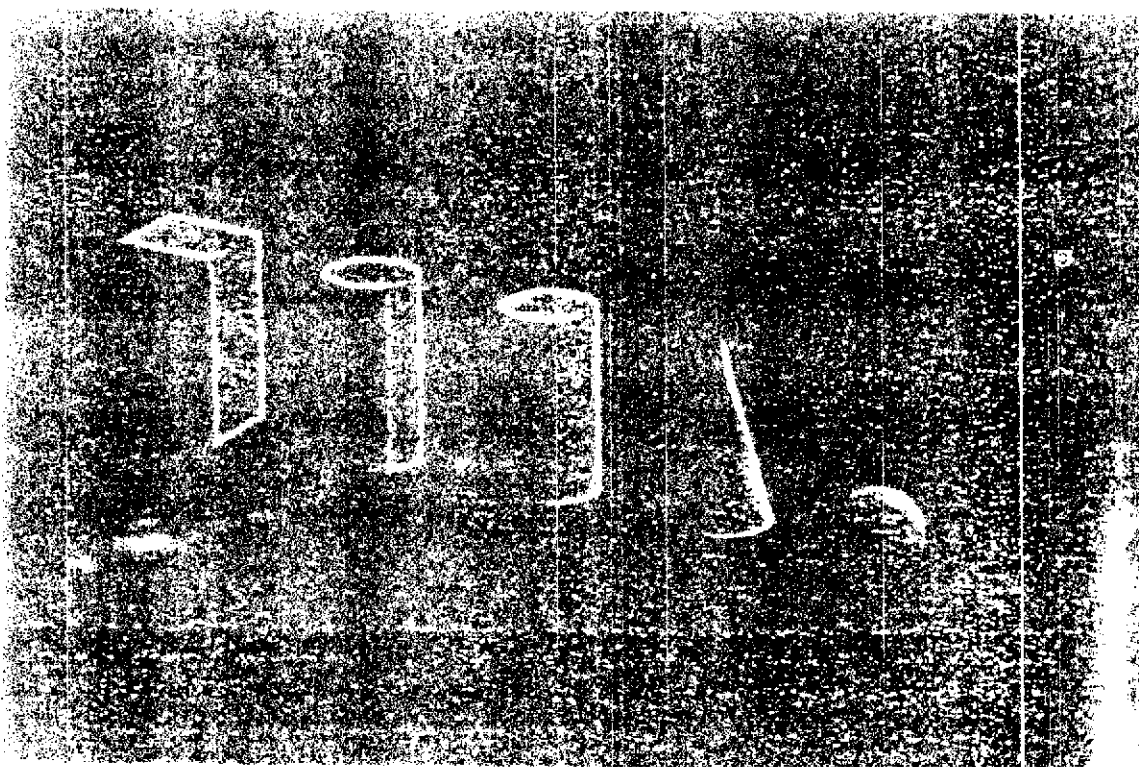
in part, as hemispherical domes, quarter-sphere apses, and so on.

If we consider these various types of solids in uniform, diffuse, and directional light, we obtain a vocabulary of basic shading effects. (see Figure 9). The

plane-faced polyhedra yield uniformly shaded polygons, with varying intensities according to angle with the light, and sharp edges. The cylinder gives surfaces with intensity varying in parallel bands. Depending on light direction and background intensity, both edges


$$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}$$


• *Staphylococcus aureus* • *Staphylococcus epidermidis* • *Staphylococcus saprophyticus* • *Staphylococcus sciuri* • *Staphylococcus* spp.



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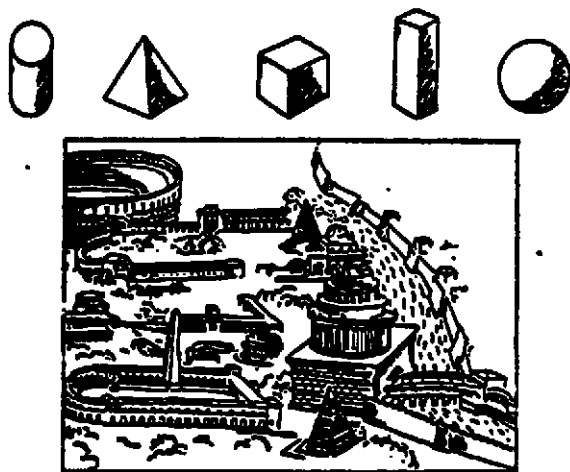


Figure 10. "Everything is spheres and cylinders": sketch by Le Corbusier from *l'Esprit Nouveau* (1920).

planar faces (see Figure 11), alignments of faces to a line or plane such as the edge of a street, as illustrated in Figure 12, and coaxial relations of symmetrical objects as shown in Figure 13.

SPATIAL RELATIONS OF TOUCHING SOLIDS

Discrete solids may be in contact with each other at vertices, along edges, or at faces (see Figure 14). The

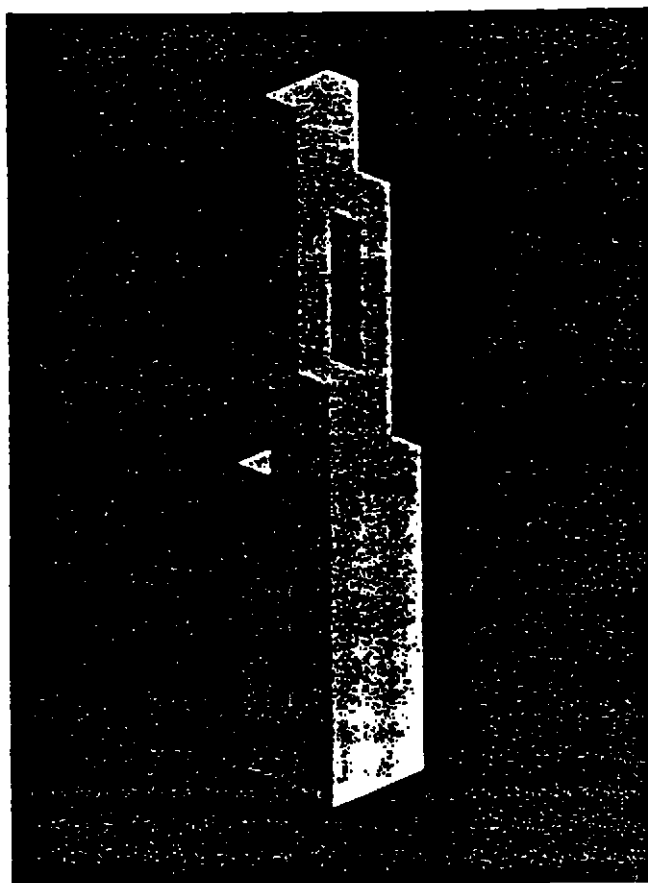


Figure 11. Parallel and perpendicular relations of planar faces in Sears Tower, Chicago.

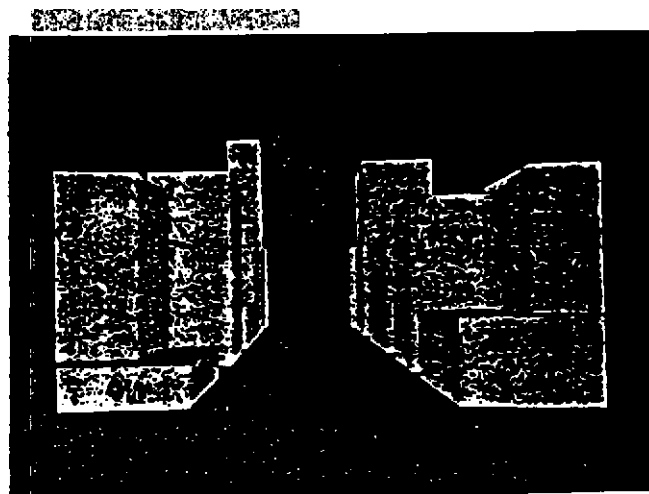


Figure 12. Alignment of faces.

most common and most important of these relations in architecture is the contact of polyhedra (and occasionally cylinders or cones) at plane faces. One face may fit within another, there may be coincidence of certain

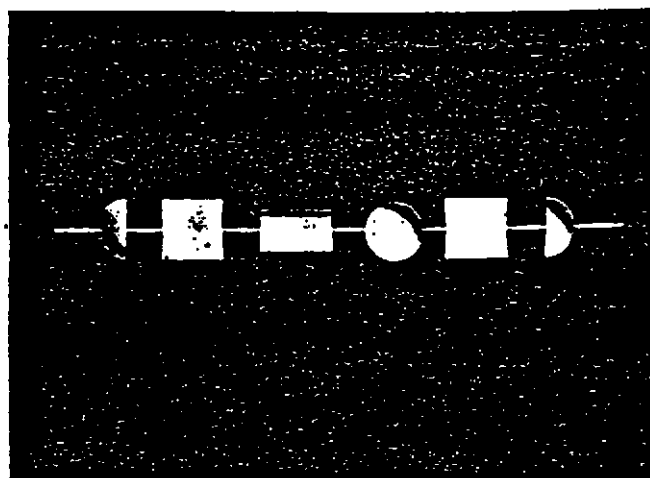
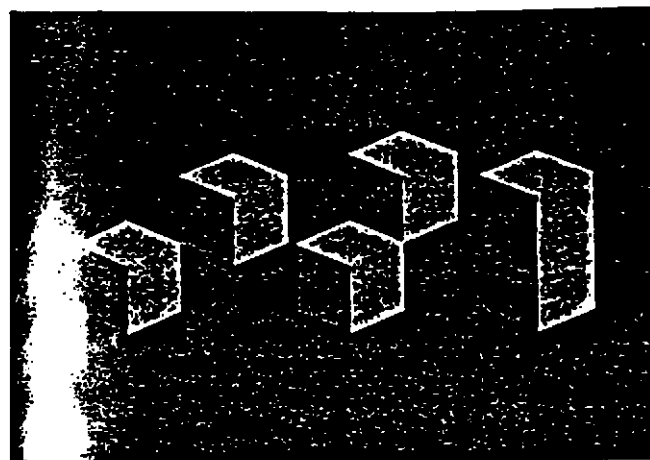


Figure 13. Coaxial relations of symmetrical objects.



14. Contact at vertices, along edges, and at faces.

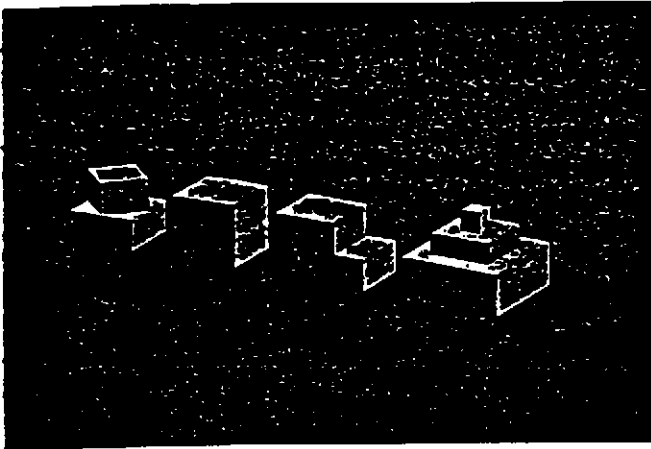


Figure 15. Cases of contact at plane faces.

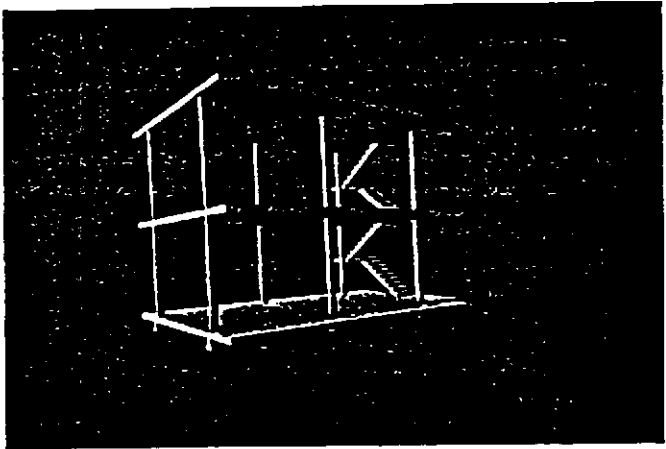


Figure 17. Le Corbusier's "Maison Dom-ino" (1929).

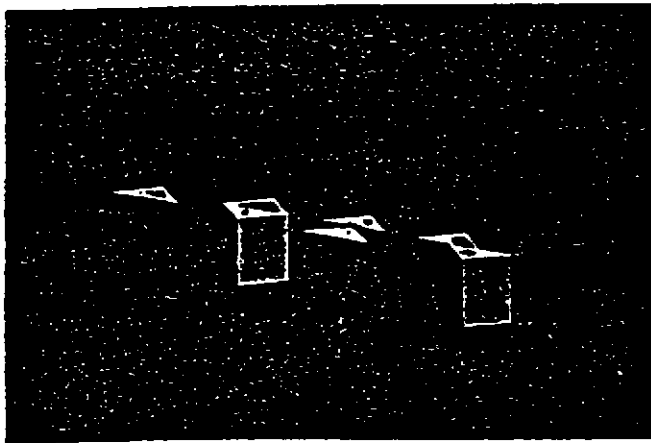


Figure 16. A combination of two instances of a solid may have greater symmetry ((a), left), the same symmetry ((b), middle), or less symmetry ((c), right) than the original.

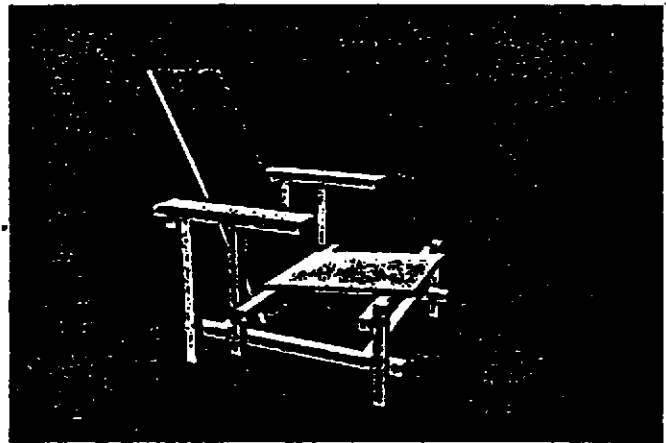


Figure 18. A chair composed of rectangular parallelepipeds.

vertices or edges, the two faces may fit, or there may be partial overlap (see Figure 15).

The possible spatial relations of touching solids may also be classified according to their degrees of symmetry. When two symmetrical solids are placed in contact, the resulting arrangement may have greater symmetry, (see Figure 16(a)), the same symmetry (see Figure 16(b)), or less symmetry (see Figure 16(c)) than the constituents. Usually it is straightforward to enumerate the possible symmetrical relations of a pair of solids.

Many architectural compositions can be understood in terms of a small vocabulary of elementary solids, and the use of just a few relations to arrange them in contact with each other. Consider, for example, Le Corbusier's Domino House (see Figure 17) or the famous chair, illustrated in Figure 18.

When a simple spatial relation of solids in contact is formed recursively, the composition that results may be rich and surprising. Figure 19 illustrates an example.

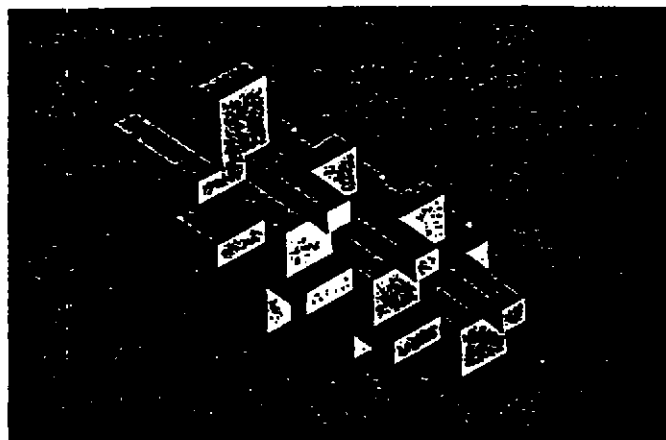


Figure 19. A simple spatial relation of rectangular parallelepipeds is formed recursively to generate a complex composition.

OVERLAPPING SOLIDS AND THE SPATIAL SET OPERATIONS

Physical solids, such as wooden blocks, can be disjoint, or they can touch, but they cannot overlap in

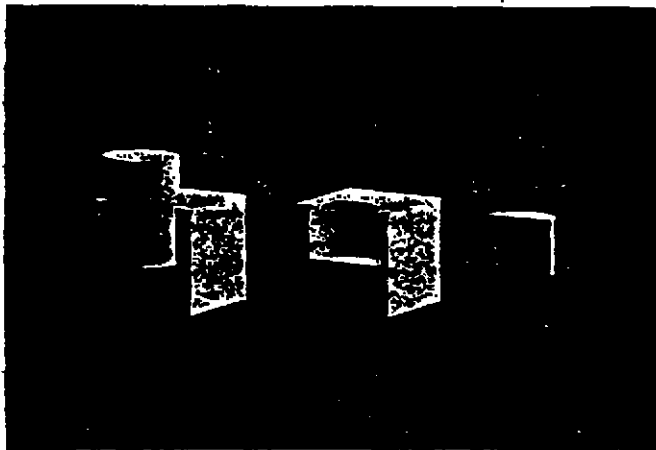


Figure 20. Union, subtraction and intersection of box and sphere.



Figure 22. The geometry of pointed vaults.

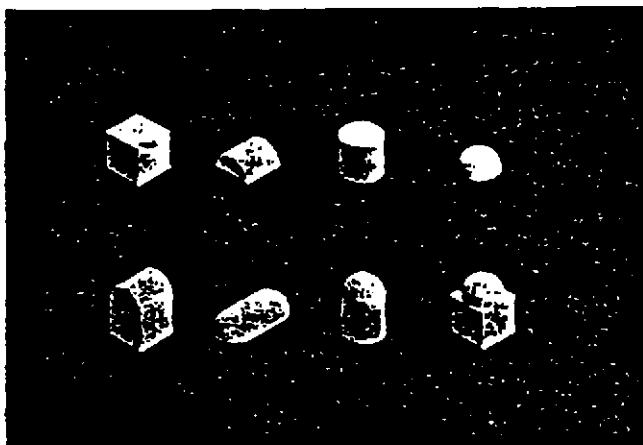


Figure 21. An architecture of straight lines, arcs, cylinders and spheres.

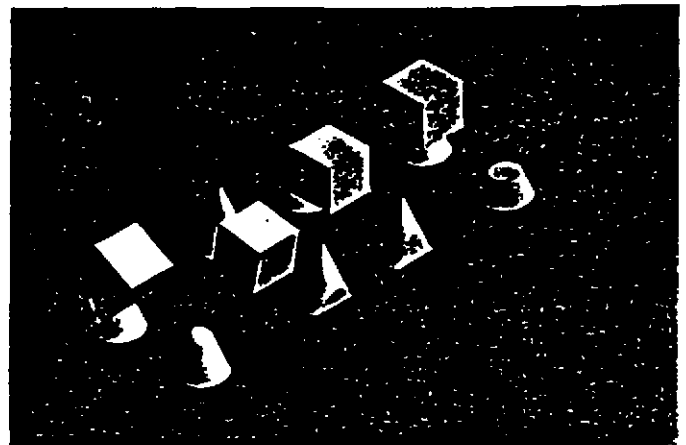


Figure 23. Conic sections.

space. Designers often find it useful to imagine such overlaps, however, and to consider the new solids that result from the union, intersection, and subtraction operations performed on overlapping solids (see Figure 20). Solid modeling software standardly provides these spatial set operations for shaping solids.

When the spatial set operations are applied to a given architectural vocabulary, the architect must consider the forms of the lines that result from intersecting faces. Are such lines physically realizable, using the available construction technology, and are they aesthetically desirable?

Some architectural styles are characterized by the use of plane-faced polyhedra only, so that intersecting faces always form straight lines. Where plane faces are allowed to cut spherical faces, circles and arcs appear. Characteristically, in Roman, Byzantine, Romanesque and Ottoman architecture, planes are allowed to cut other planes, spheres, and cylinders to produce an architecture of domes and barrel vaults, with straight lines, arcs, and circles showing up in plan and elevation (see Figure 21).

Gothic architects sometimes allowed the cylinder to be cut by an angled plane to generate an elliptical line. In their explorations of vaulting forms, they spatially related cylindrical surfaces in many different ways to yield circular and elliptical arcs at edges and intersections (see Figure 22).

Where planes are allowed to cut conical surfaces, straight lines, circles, ellipses, parabolas and hyperbolas can result (see Figure 23). Guarino Guarini was probably the first to systematically explore the rich and complex architectural possibilities that emerge from this.

DESIGN BY UNION

Let us now consider a vocabulary of rectangular parallelepipeds and triangular prisms. Simple rectangular plan buildings, with various roof forms, may be produced by performing union operations (see Figure 24).

Cruciform, L-shaped and sawtooth forms can be produced by taking some of the results and union

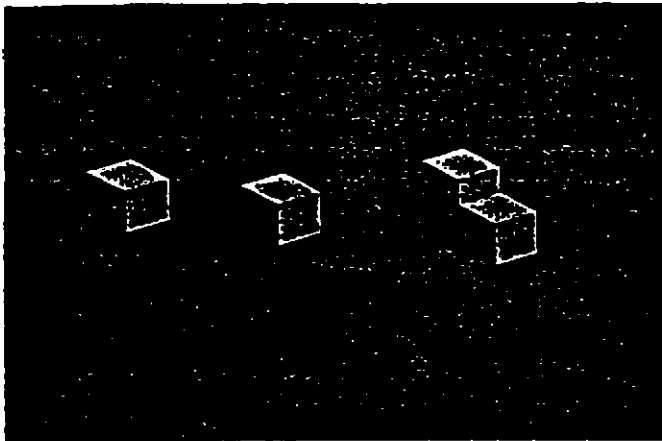


Figure 24. Simple building forms generated by unioning boxes and wedges.



Figure 25. More complex forms generated by unioning again.

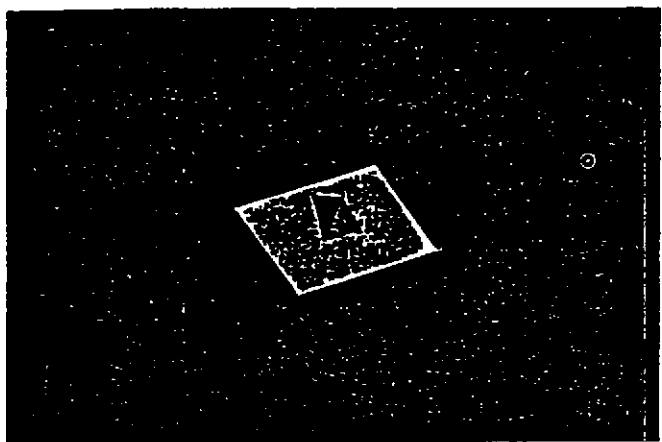


Figure 26. Dormers and attics can be produced by unioning.

ing again (see Figure 25). Dormers and attics can be produced in a similar way (see Figure 26).

Add the square pyramid to the vocabulary, union this with the triangular prism, and a hip can be produced (see Figure 27). Further unioning can then pro-

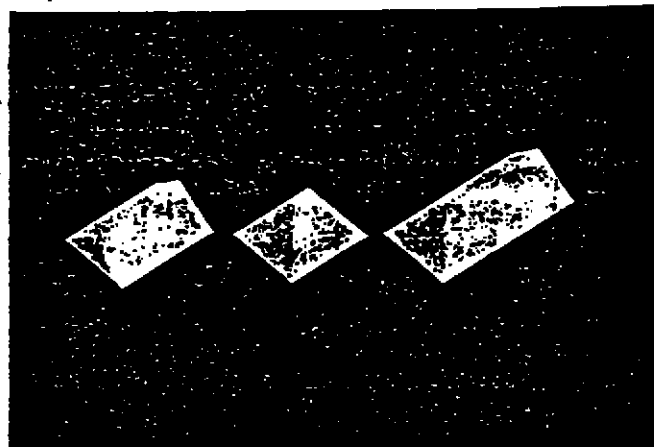


Figure 27. A hip roof is formed by unioning a triangular prism with a square pyramid.

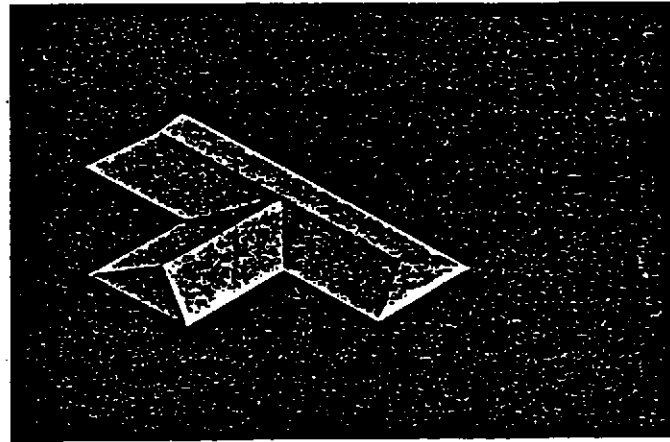


Figure 28. Union of simple hip roof forms.

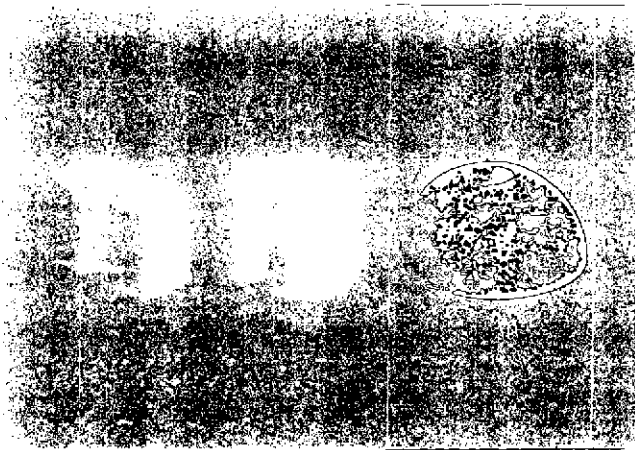
duce the characteristic roof forms of Frank Lloyd Wright's prairie houses (see Figure 28).

DESIGN BY SUBTRACTION

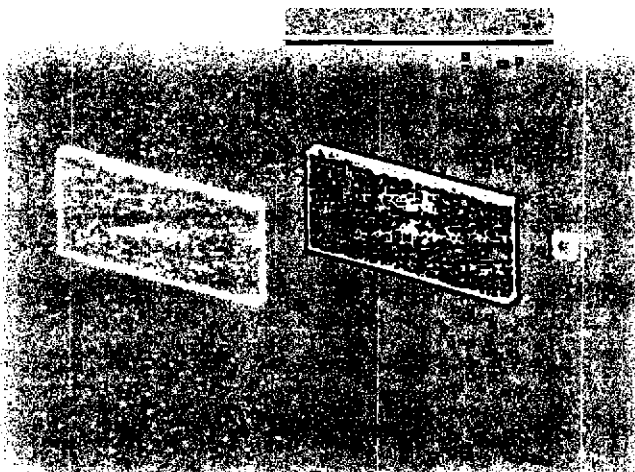
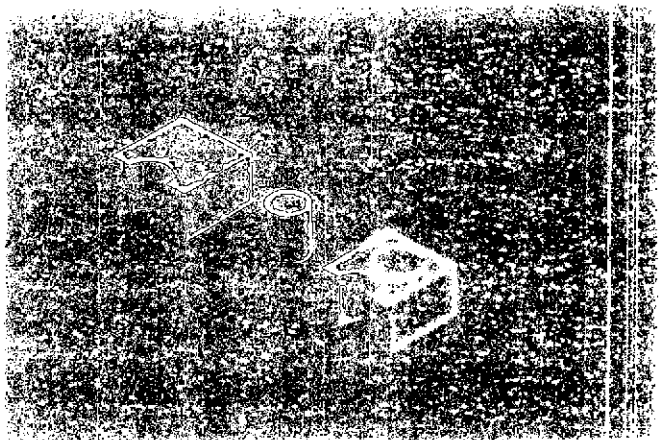
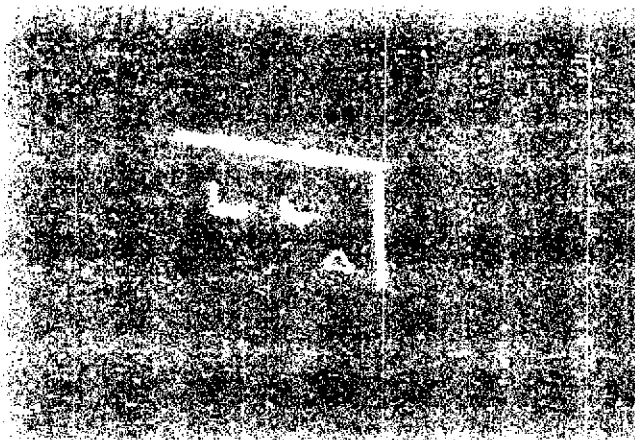
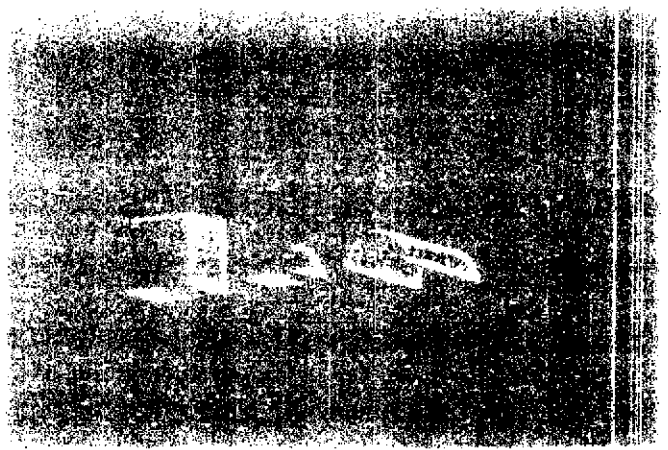
Some architectural forms are, by definition, subtracted volumes. A semicircular niche, a flute on a column, and the oculus of the Pantheon, are all formed by subtraction of a cylinder from another solid (see Figure 29). Simple openings in walls can be created by subtracting prisms or cylinders (see Figure 30). Window openings like those at Ronchamp, as in Figure 31, are formed by subtracting pyramids.

Hollow forms result when a scaled-down copy of a volume is subtracted from the original volume. Hollow cubical boxes, hollow barrel vaults, and hollow hemispherical domes are all produced in this way (see Figure 32).

The outer solid need not, of course, mimic the form of the subtracted interior void (although some architects have taken this to be a virtue). In Baroque architecture, for example, interior and exterior forms typi-

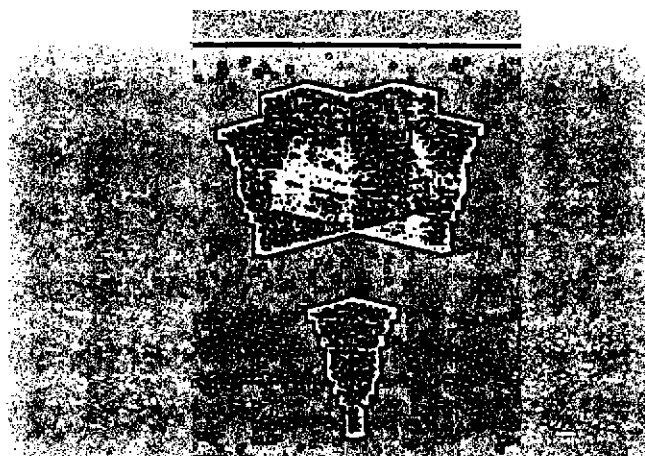
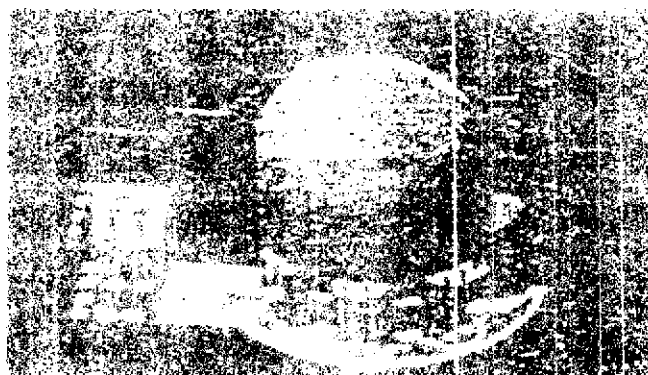
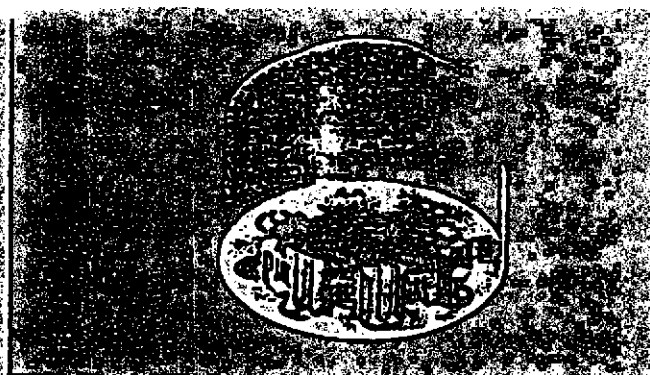
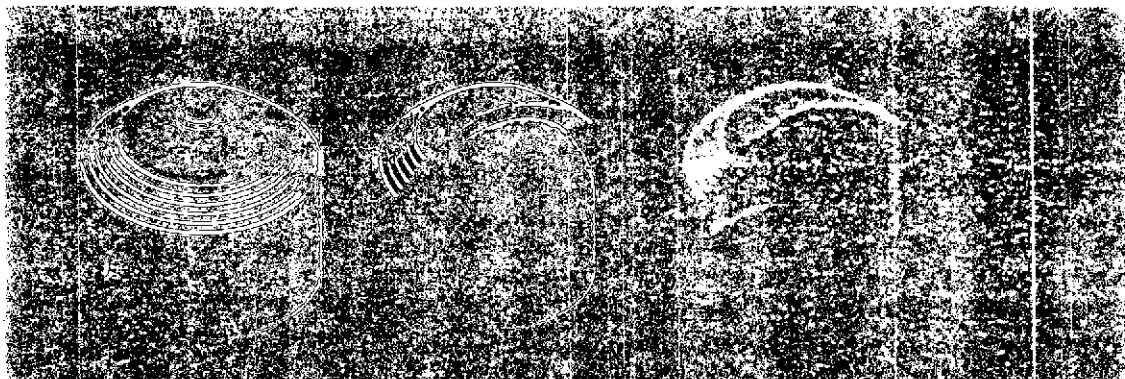
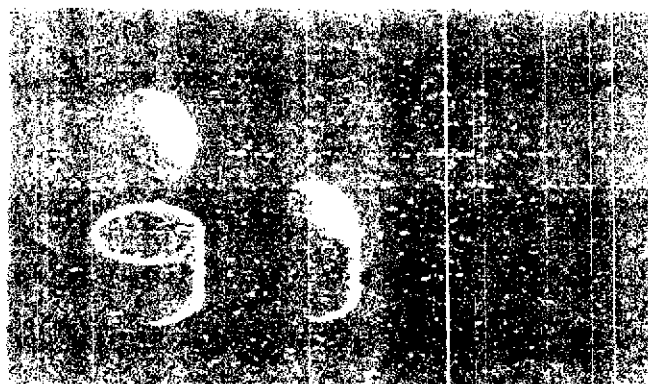
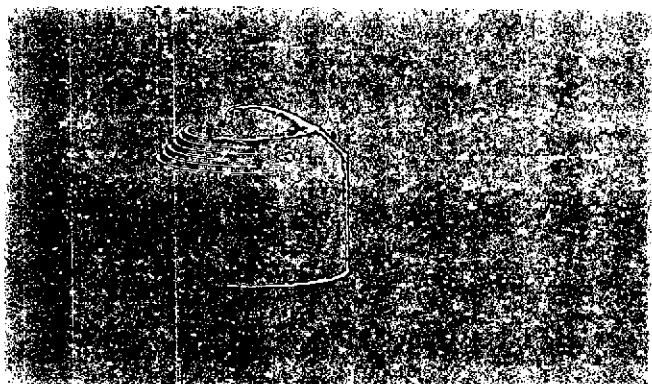


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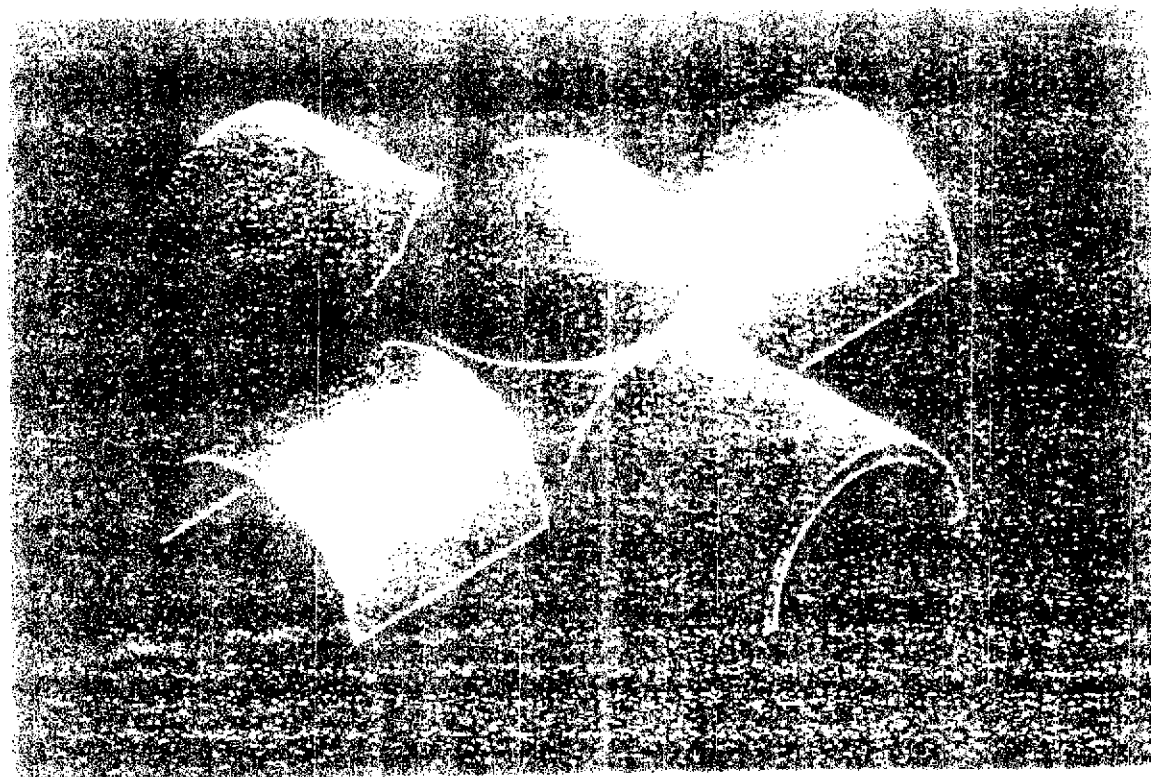
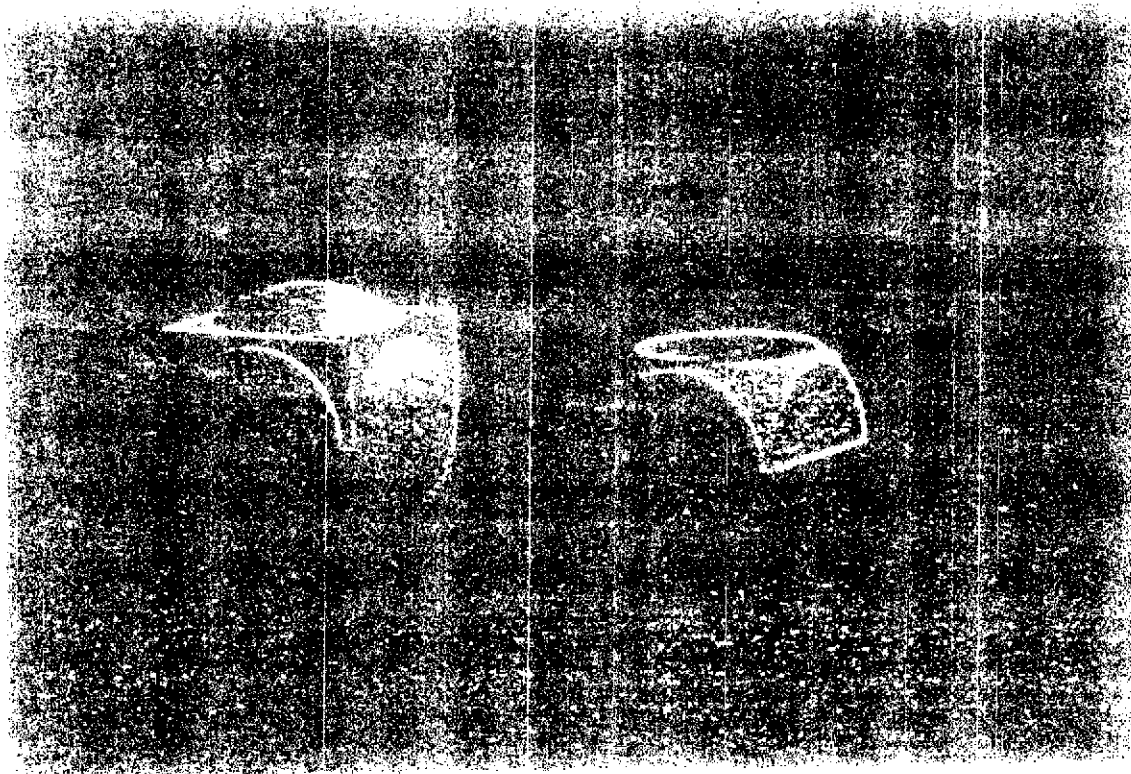
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MITCHELL: SOLID



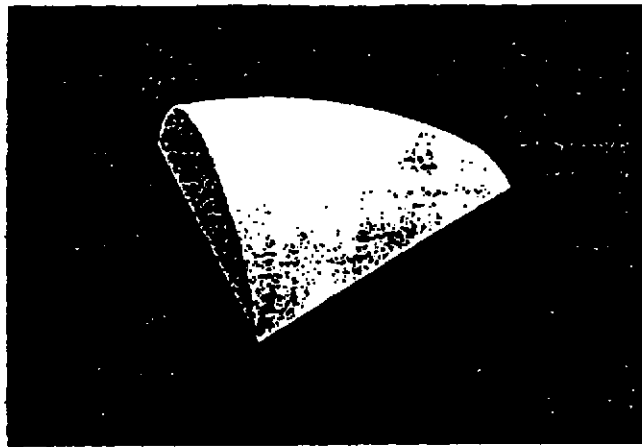


Figure 38. Eero Saarinen's Kresge Auditorium at MIT.

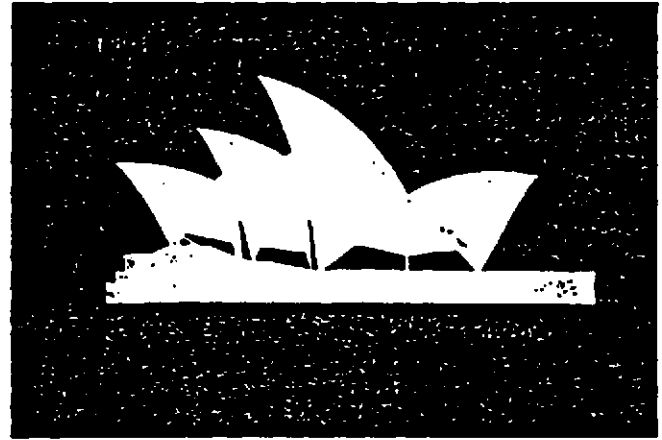
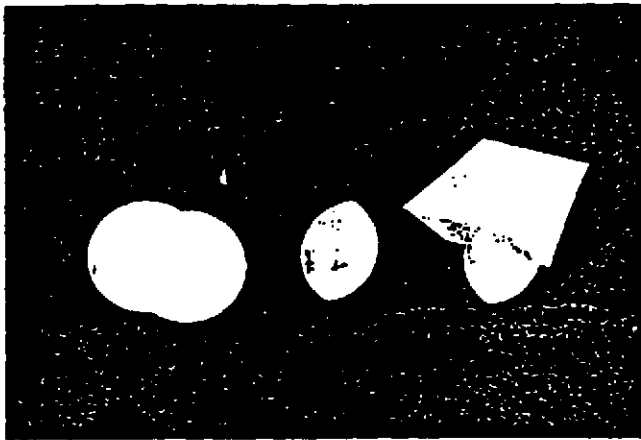


Figure 39. The shells of the Sydney Opera House.

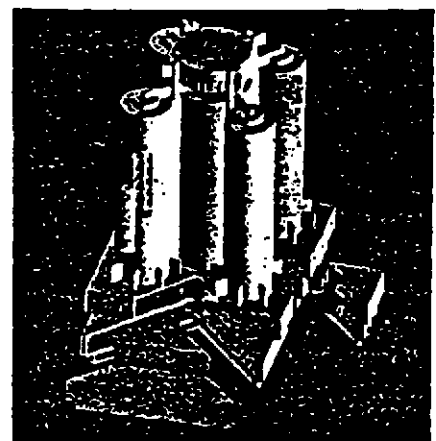
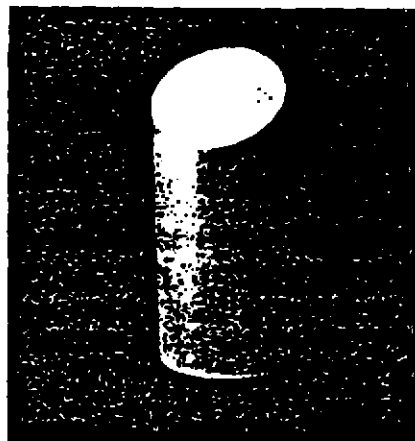
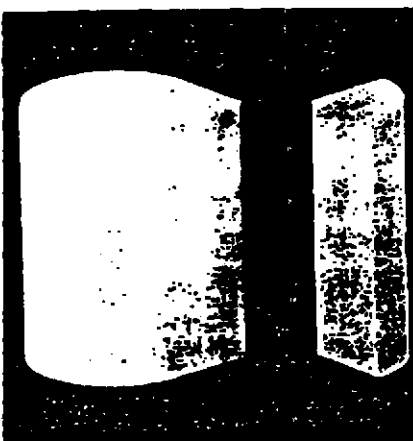
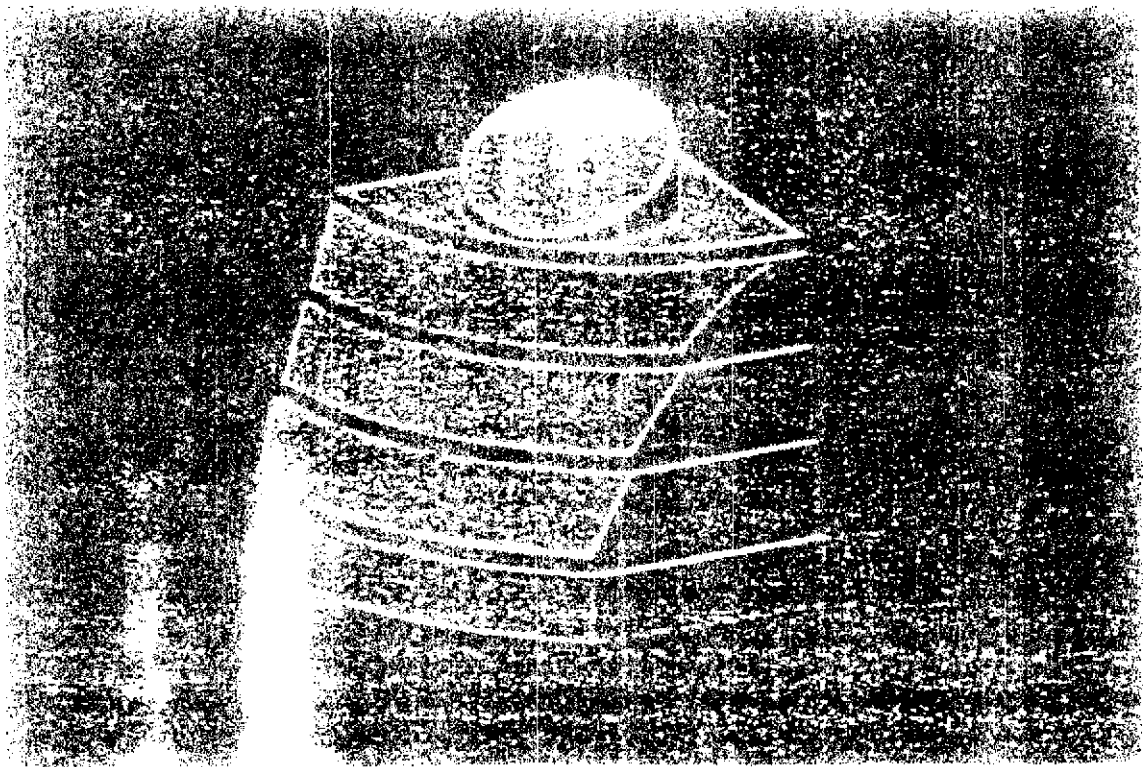
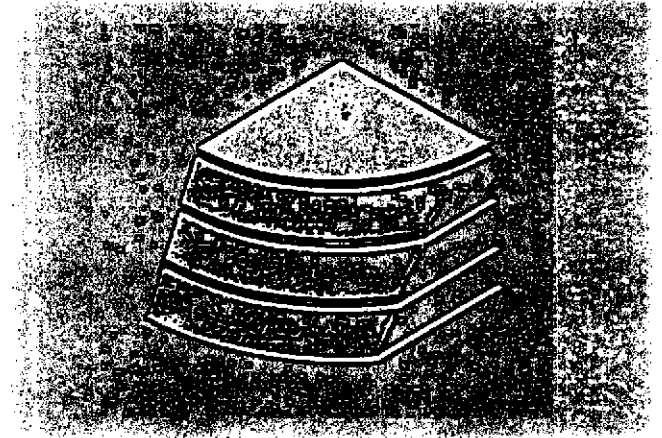
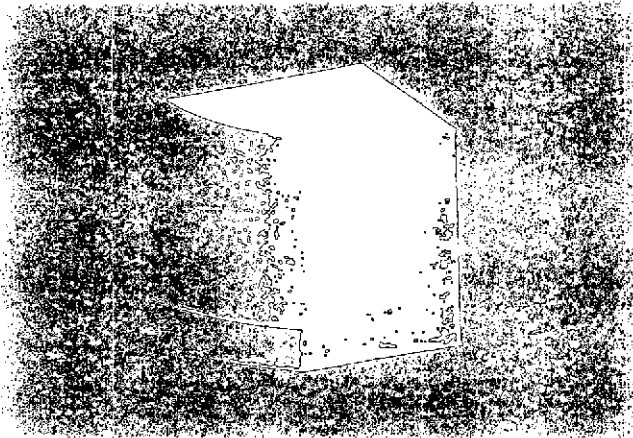
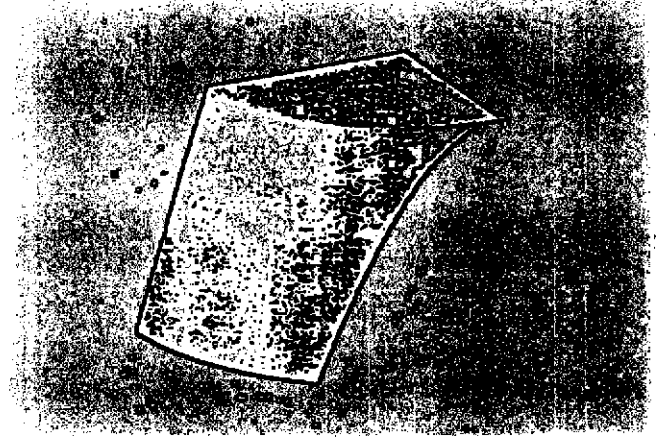
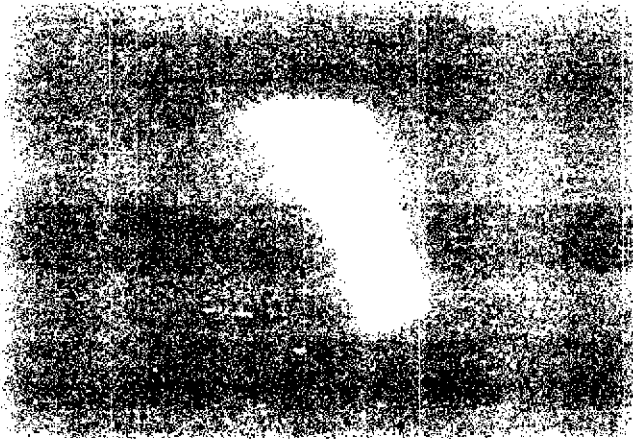


Figure 40. A highrise building form results from intersection of a cylinder and a rectangular block.



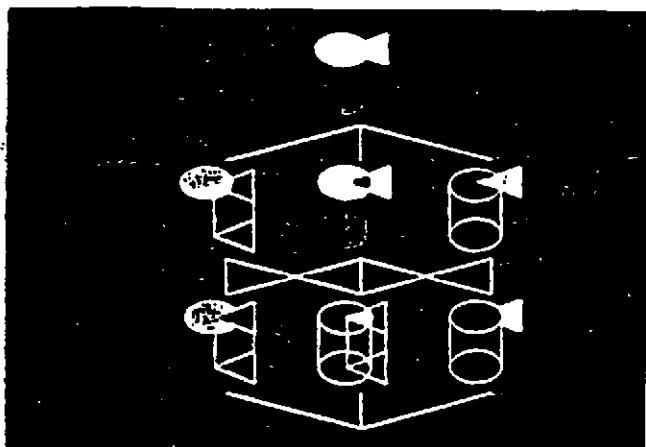


Figure 42. A Boolean lattice defined by two solids.

Figure 36; the result is the required pendentive form. Familiar dome and vault assemblies can then be created by unioning spherical and cylindrical forms (see Figure 37); notice how the interfaces are all circles, arcs, squares and rectangles.

Forms other than rectangular boxes may be intersected with spheres to form interesting spherical fragments. Kresge Auditorium at MIT, for example, is generated by intersecting a triangular prism with a sphere (see Figure 38). The sail forms of the Sydney Opera House can be produced by first intersecting spheres to create a lens shape, then intersecting the lens with a triangular prism (see Figure 39).

Massing concepts for urban buildings sometimes result from the intersection of symmetrical solids with the rectangular volume defined by the edges of a city block bounded by streets. A cylinder, for example, might become a high-rise building with some curved and some planar faces (see Figure 40).

The basic form of the State of Illinois Center in Chicago (see Figure 41) is produced by intersecting a cone with a rectangular box defined by the street grid. (Notice how a hyperbola results on one face.) Refinements are introduced by slicing the cone into horizontal segments, and intersecting those with cylinders. A second major volumetric element results from the intersection of a cylinder with a wedge. Finally, the sliced cone and the sliced cylinder are unioned.

IMPLIED VOLUMES AND SPATIAL COMPLEXITY

Volumes positioned in space, together with the spatial set operations, define a Boolean lattice (see Figure

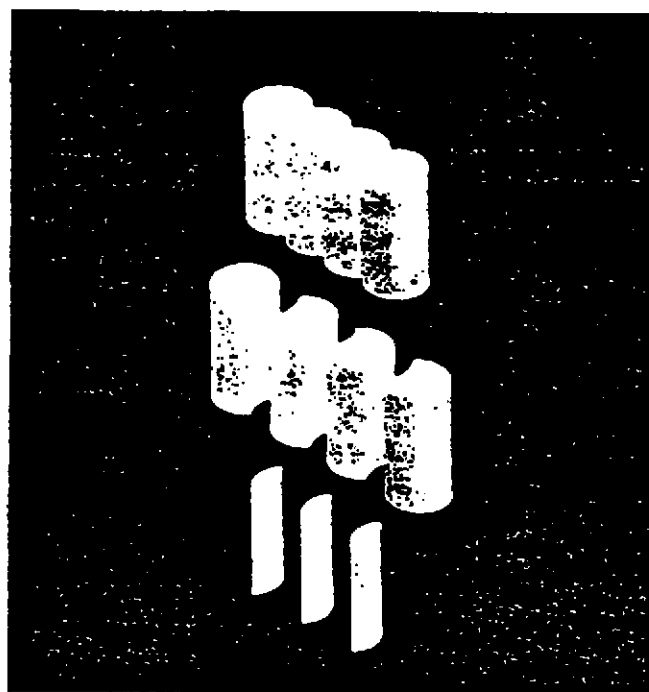


Figure 43. Volumes defined by overlapping cylinders.

42). Positions in the lattice correspond to possible shapes, and links correspond to shape formation operations.

When we see a composition created by overlapping elementary volumes and performing spatial set operations, other shapes in the Boolean lattice come to mind. Baroque architects, in particular, exploited this to produce effects of spatial complexity. The basic interior volume of a Baroque church might, for example, be formed by unioning overlapping cylinders (see Figure 43). But we can also read the implied intersections and subtractions. Frank Lloyd Wright played similar games with interpenetrating rectangular volumes.

CONCLUSIONS

Volumetric composition is an important, traditional architectural design strategy. Until now, volumetric ideas have been explored by sketching and through the use of physical models. The development of solid modeling systems has not only provided a convenient way to represent building massing concepts, but also a new way to generate and explore compositional concepts.

Hyper-Reality
Assorted Newspaper Articles

Mark Landen Crosley

San Francisco Chronicle
1989 / 1990

Welcome to the World of Hyper-Reality

Computer system puts you in the picture

BY SHANN NIX
CHRONICLE STAFF WRITER

Joan stands over by the window. Her head is on upside down, but that's OK.

It's her day off.

The room behind Joan is constructed of smooth, sliding sheets of color, bright enough to make you dizzy. The light switch is the size of a watermelon. The table is red. The bar is orange. A ceiling fan revolves slowly overhead, and a chunky geometric jungle gym occupies the far corner.

You are wearing a blue jacket and a black tie. You have no legs, but it doesn't seem to slow you down.

Turning your head from side to side, your perspective shifts slowly, a little jerkily, like an old film. You hold your hand up in front of you — it looks like a cartoon hand, flesh-colored but strangely thin, with unfamiliar shadows.

Make a fist, and your hand makes a fist. Stick out your first two fingers, and you shoot across the room, through the wall and into the outside world, where the mountains are huge brown triangles and the sky is flat.

You're in Jaron Lanier's virtual reality, a computer-based simulation of a world that doesn't exist in real time or space.

It's hard to convince your senses of that.

"The implications are staggering," says Lanier, 29-year-old founder and CEO of VPL (Video Programming Language), the Redwood City-based company responsible for the system. "It's weirder than science fiction — it's a new level of reality. There's never been another one except for the physical world, unless you believe in psychic phenomena. And we don't know what's out

there."

Lanier's work with computer-generated reality is turning the industry upside down. A simulated world that you can see, explore and change is the latest and most unnerving development in the computer revolution, one that may change the way we think about art, entertainment, medicine, leisure, design, travel and reality itself.

The guru of virtual reality is a soft-voiced, nervous young man with the body of a couch potato, the dreadlocks of a Rasta man and the wide eyes of a prophet.

Lanier, who never received a formal degree from any institution, including a high school, came to California from New Mexico in 1981, driving a bullet-riddled car he borrowed from a drug smuggler. He went to work for Atari, programming the sound portion of video games, and ended up making his first fortune designing the Moon Dust video game.

VPL started with a bunch of Lanier's friends tinkering with computers in the garage and cooling overheated discs in the refrigerator. They're all young, mostly single, and still spend most of their time playing with computers. But these days Lanier and his buddies work in a ritzy complex overlooking the bay, making headlines with their revolutionary computer-generated reality.

How It Works

Here's how virtual reality

works: You are wearing equipment that is plugged into a central computer. The EyePhone goggle system, originally developed at NASA in the '60s, has one tiny television screen for each eye that together provide a 3-D image. A sensor keeps track of the movements of your head, so that as your head moves, the computerized scene shifts accordingly.

VPL's DataGlove is a lightweight Lycra glove wired with fiberoptic cables that interpret and transmit hand movements, mimicking them with a miniature phantom hand in the computer.

For serious devotees, there's the DataSuit, a Lycra bodysuit with fiberoptic cables running its entire length, allowing you to project a phantom body into the computer-generated reality. Your computer body, which may resemble any life form you choose, will follow your motions and spatial orientation.

The latest and most startling development is the "Reality Built for Two" (RB2), a modem system that allows two users to be in the same virtual room simultaneously, even when separated by vast physical distances. Users can see each other's computer bodies and communicate and interact, just as you might interact with Joan, the computer construct with the upside-down head.

The technology is expensive. RB2 for two people costs \$69,925, and EyePhones will put you out \$9,400. There are two versions of the DataGlove: one used by researchers that costs \$5,800, and a cheaper version called the Powerglove, which can be used as a controller for the Nintendo video game. The Powerglove has been licensed to Mattel Inc. and should be in the stores in time for Christmas.

Now, virtual reality is used largely by architects who can design a house and walk clients through the actual layout, moving doors, walls and windows as they please. But Lanier believes the medium's possibilities are endless.

"Imagine a class of kids walking through a prehistoric forest, watching a dinosaur being born out of an egg, and then becoming a dinosaur themselves, looking down on the tops of the trees. You could turn yourself into anything you wanted to study — get a first-person view of the whole universe."

The most significant thing about the system, Lanier says, is that for the first time, you can handle computer images as if they were three-dimensional — you can pinch images and leave a dent.

Chemists could handle models of molecules, to see whether they fit together. An astronaut inside a space station could operate a robot repair unit outside. Students could hold atoms in their hand, build proteins, become giant strands of DNA and wiggle into place.

Using robots, nuclear waste could be cleaned up without endangering human life and doctors could perform surgery on someone in another country.

These things exist in the not-so-distant future, Lanier said. By the turn of the century, many of VPL's fantasies will be reality.

The Concerns

In the workroom at VPL, tool boxes, sketches and piles of electrical cord litter the tables along the walls. The center of the room is empty, so that people immersed in the virtual reality won't bump into physical objects — one of the dangers of the trade.

There are other concerns, as well. In a few years, software programs will allow users to create and enter their own infinitely variable worlds, which can be changed at will. Is the American public ready?

"My nightmare, of course, is that there will be some kind of damage as a consequence of this," says Lanier. "I feel very responsible. I think any technology that makes people more powerful or smarter is probably bad technology, because people are too smart and powerful already."

"But virtual reality is interactive, more like a super telephone than a television, because it doesn't give you messages — you create it. It's not over-simplified or violent, like a video game."

"I have had to physically yank a few people out of the chair," he said. "But the look of virtual reality is still a little primitive and cartoonish. You get to miss the textures of the physical world."

"So in those terms, virtual reality is exactly as real as the physical world, no more, no less."

The big difference between virtual reality and physical reality is that physical reality is more stubborn. It would take a lot of trouble to destroy this building, for example. But in virtual reality I can make it turn into a tulip. I can become the building and crawl around looking out of the air shaft.

"Virtual reality is like a huge costume party. But instead of just the people dressing up, the whole world is in drag."



BY STEVE BRIGMAN/THE CHRONICLE

By wearing goggles fitted with a tiny TV screen for each eye and a glove wired with fiberoptic cable, Jaron Lanier enters his "virtual reality," a simulated world you can explore and change.



Scott S. Fisher is Research Scientist, Aerospace Human Factors Research Center, at NASA Ames Research Center, Moffett Field, California. He is director of the Virtual Environment Workstation Project at NASA Ames, in which objective is to develop a multisensory "virtual environment" workstation for use in Space Station teleoperation, telepresence, and automation activities. He has consulted for several corporations in the areas of spatial imaging and interactive display technology.

Telepresence in Dataspace Scott S. Fisher

OK. So, we've reached a point where some predict that the PC of the future might instead be called a PS—a Personal Simulator. A mutant super-PC combined with a head-coupled stereoscopic visor display and human-matched I/O devices that completely immerses the user in a real-time, multisensory, interactive, computer-generated, do-everything user interface called a Virtual Environment (a.k.a. Virtual World, Artificial Reality, Cyberspace, etc.). Whatever it's called, a basic objective will be to engage the user in *Telepresence*. The net effect will be like having one of those huge flight-simulation domes in a small package on your desk, with just enough sensory feedback to provoke a sense of real presence in the simulated space.

In terms of driving forces and critical mass, it's taken only decades of prescient (and wishful) prose by numerous science-fiction writers; years of avid proselytizing by devoted stereophiles and virtual worlds zealots; and recent bootleg implementations by a hard core of virtuality hackers to attain this capability. And, of course, equally important catalysts to this development have been just-recently-available low-cost display technologies and real-time computer graphics systems that form the foundation of Virtual Environment generation. It's likely that this horizon of the virtual world, the technology in particular, will improve by orders of magnitude in the next decade, with additional performance features such as these:

- Greater than million pixel flat-panel display resolution strategically covering a 180-degree field of view and updating as fast as the viewer moves to virtually produce a very high-resolution 360-degree image surround.

- Ray-traced stereo graphics presented at greater than 60 frames per second by processors mounted in the lightweight, compact headset.

- Convertible holographic optics that allow either complete immersion in virtual worlds or a seamless overlay of animate virtual 3D graphics onto the real-world (à la "Toon-Town").

Users will be able to match their electronic personas with the 3D graphic metaphors used for representing their personal dataspace.

- Binocular eye-tracking technology to add convergence-controlled 3D cursors for selecting and manipulating objects in virtual space and to simulate realistic depth of field rendering.

- Skin-like gloves and clothes to provide interactive manipulation of virtual objects and recognition of dynamic gestures, combined with embedded actuators to respond with texture, edge, mass, and temperature information.

- True 3D auditory displays that deliver acoustically rich and spatially correspondent virtual sound sources and reflections in the virtual environments.

- Optical trackers that unobtrusively calculate viewpoint and gesture in virtual space, as well as scan and map real-world surroundings to allow real-time traveling maps and hit detection in superimpose/ToonTown mode.

Given this evolving hardware configuration, it's easy to imagine an enormous spectrum of diverse applications and environments that will be available. Entertainment and educational applications will be developed that are based on this ability to simulate a wide range of real or fantasy environments, with almost infinite possibilities of scale and extent. The user can be immersed in a 360-degree fantasy adventure game as easily as he or she can viscerally explore a virtual 3D model

of the solar system or use a three-dimensional paint system to create Virtual Environments for others to explore.

Another Virtual Environment scenario will enable the development

in flow turbulence in real time. Seismic data, molecular models, and meteorological data are other examples of multidimensional data that will be visualized easily through representation and interaction in a Virtual Environment.

Eventually, telecommunication networks will develop that will be configured with Virtual Environment servers for users to dial into remotely in order to interact with a population of other virtually present users and purely virtual agents. The users will participate and interact in this shared virtual environment *dataspace*, but each will view it from their relative, spatially disparate viewpoint. The result will be a collaborative workspace in which remotely located participants can virtually interact with some of the nuances of face-to-face meetings, while also having access to their personal dataspace facility. This will enable interaction between users collaborating from different locations across the country, or even between astronauts on a space station and research labs on Earth.

With full body tracking capability, it also will be possible for users to be represented in this space by life-sized virtual representations of themselves in whatever form they choose—a kind of electronic persona. For interactive theater and interactive fantasy applications, these virtual forms might range from cartoon figures to inanimate objects, or even different faces to different viewers. In fact, users will be able to match their electronic personas with the 3D graphic metaphors used for representing their personal dataspace. Imagine making a stock market trade in the real world by grabbing miniature replicas of industrial or office buildings from the shelves of a virtual supermarket, or searching electronic databases by doing underwater data archaeology on a virtual Jamaican reef—DataFlippers and all.

With telepresence in dataspace, almost anything will be virtually possible. ☐

SCIENCE AND BUSINESS

Show and Tell

Hypermedia turns information into a multisensory event

A high school student, assigned a report on women in American history, turns to a computer system tied to a video monitor and watches a short film on immigration. Using a computer mouse, she stops the video on a picture of a woman; a "notecard" with information on women immigrants appears on her computer screen. Her curiosity piqued by a reference to the garment industry, the student locates another clip on industrialization and sees pictures of women in sweatshops. Along the way she collects snippets of the images in an electronic file to supplement the report she will write. Elsewhere, a telephone company executive weighs what new services to offer to clients. His computer illustrates each of the services under development at Bell Communications Research (Bellcore); when prompted, it offers more detail—notecards about the software and technology needed to implement a service or the likely costs and advantages.

These snapshots illustrate hypermedia, a new way to manage information. The American history project will



*High-tech texts,
Taguchi methods,
a nose for wine,
inflated measures*

be released by *National Geographic* (in conjunction with Lucasfilm) in January; several telephone companies already use Bellcore's package. Just more data bases? No, say software developers. Hypermedia is a different way of organizing information in many media—text, pictures, video clips and sound. It relies on computers, videodisks and monitors to create a multimedia library, tailored to a user's needs.

Hypermedia systems range from classroom products drawing on fixed, limited data bases to complex programs for managing changing streams of information in business and technology. Their common thread is non-linearity—in effect, the lack of a single thread. Rather than leading a person

straight through the information, hypermedia allows each user to cut his or her own path. More fundamentally, hypermedia is another step away from systems for the computer intelligentia and toward systems that better accommodate how most people think.

The inspiration for hypermedia was a 1945 article in the *Atlantic Monthly* written by Vannevar Bush, who directed the U.S. Office of Scientific Research and Development during World War II. Bush predicted that science would develop a new approach to organizing information. In his scenario, a "memex"—a sort of intelligent agent—would help people to create customized data bases.

The technical foundations for hypermedia were laid in the late 1960's. Yet it took relatively cheap, powerful computers and data-storage technology (such as videodisks) to make hypermedia practical. In 1987 Apple Computer released its "HyperCard" software, which quickly became a platform for a host of projects, including those of *National Geographic* and Bellcore. HyperCard works much like an electronic index-card file. Facts are stored on electronic notecards that can be shuffled into any desired order.

Tying cards to slides, video clips and sound—the essence of these early hypermedia projects—can transform classroom lessons, says Kristina Hooper, director of the multimedia laboratory at Apple; students can, for example, read notes about a scientific discovery, hear an interview with the lead scientist and explore diagrams that detail the finding. One of the first products is a package on the 1988 election created by ABC News and Optical Data in Warren, N.J.; another, on the conflict in the Middle East, is slated to be available this summer.

John Steinbeck and Shakespeare are also being adapted to hypermedia. Along with reading *The Grapes of Wrath*, students can learn about the Great Depression by tapping into fire-side chats by Franklin D. Roosevelt, crop statistics and Woody Guthrie songs. Students of Shakespeare can "stage" his plays electronically, drawing on a wide cast of characters stored on videodisk. For medical students, the "Electric Cadaver" at the Stanford University Medical Center offers a tour of anatomy. Start with a full skeleton, then examine a shoulder joint. Or



HYPERMEDIA can link video to a data base of facts. In this presentation on DNA, developed jointly by Apple Computer, Lucasfilm and the Smithsonian, students can learn the science behind the story by stopping the video and exploring the computer data base. Photograph by Ed Kashi.

stimulate a nerve and watch the effect on other body parts. "When you reach a critical mass of interrelated material, this kind of system is extremely useful," says Steven J. Freedman, a developer of the project. (Freedman expects the "Electric Cadaver" to be on the market in 1990.)

Critics argue that splashy videos and other media can add more gum-muckery than substance. Computer-generated multimedia presentations may merely "imitate television's habit of creating increasingly stimulating experiences rather than imparting knowledge," writes Nick Arnett, editor of *Multi-Media Computing & Presentations*. But educators have become increasingly sensitive to students who do not readily learn from print. If they can absorb information more easily from hypermedia, the new technology will be a valuable classroom tool, observes Mary Alice White of Teachers College, Columbia University.

Other researchers have moved beyond cards and are trying to build hypermedia systems that make full texts—such as manuals and books—more accessible. People searching for information, even thumbing through a book, immediately locate what they need only about 20 percent of the time, observes Thomas K. Landauer, a

Bellcore manager. So Bellcore's "SuperBook" features particularly flexible searching techniques. (Given a key phrase, it will identify sections even when the words in the phrase are out of order.) SuperBook also condenses chapter headings before and after a selected section to give a "fish-eye" view of the surrounding material.

Organizing chunks of information into nonlinear webs also appears to be well suited for managing highly complex projects, researchers say. The Microelectronics and Computer Technology Corporation (MCC), for instance, is using hypermedia in a system for managing the production of new software. Several years ago officers on board the USS *Carl Vinson* used an experimental hypermedia system built at Carnegie Mellon University to help manage the aircraft carrier; Westinghouse has similarly explored how hypermedia might provide nuclear-power plant operators with easy access to information during emergencies. Knowledge Systems in Pittsburgh now sells a commercial package based on those prototypes.

Many of these hypermedia systems incorporate other software tools, including expert systems. Building on Knowledge Systems's software, Bellcore is creating a hypermedia package

to help regional companies develop business plans and oversee their subsidiaries. If a company adopts rules specifying that its subsidiaries should not compete with one another, the system can flag the conflict for managers. The benefit of hypermedia? Conventional expert systems are best used by those trained in computer science; hypermedia can be understood by anyone, say Bellcore workers.

Yet hypermedia designers still face many issues. Is there enough information—both text and video—available for comprehensive presentations? (Even *National Geographic* and ABC have had to seek additional sources.) Will laser disks become obsolete in the face of newer storage technologies? What features will make hypermedia systems valuable and easy to use?

What is clear is that hypermedia is not a single invention—like the transistor—that can be easily copied and exploited by many companies. "Each company will have to work out how to use hypermedia in a way specific to its own need to organize information," says David L. Turock, a Bellcore manager. Those companies that grapple early with how to structure information, he predicts, will build the strongest leads in the information race.

—Elizabeth Corcoran

IN THE KOREAN BUSINESS COMMUNITY: CLOTHES DON'T MAKE THE MAN, TITLES DO.

Age, status and experience are what count in Seoul! A bright, young executive is not impressive in fact; if you are setting up the very first meeting between two companies, try to make sure at least one of the people representing you is over 50 or quite highly ranked.

ROOM WITH A VIEW: If you want a hotel that's not jammed in the center of the frenetic city, but is still only moments from everything, you should try the

Hyatt Regency. It's on a hill in Namsan Park and is lovely and peaceful. The best views are to the south.
747-7 Hannam-dong,
Yongsan-ku. Tel: 798-0061.

SLOW IS ALWAYS

BETTER! Every meeting begins with a bit of conversation and socializing before you attend to business. Don't rush into the agenda; instead, take the time to make everyone feel comfortable. As you get to know each other, things eventually will start moving faster.

FRANKLY, MY

DEAR... If you need a break from all your meetings, an American movie could be the ticket: Escape to the Piccadilly—Tel: 765-2245.

NORTHWEST NOTES:

We offer you convenient daily service to Seoul from over 200 U.S. cities. And, in addition to our all-747 fleet, we give you something no other U.S. airline can—the insight that comes after 40 years of helping people do business in Asia.



LOOK TO US, NORTHWEST AIRLINES.

Here Comes Hypermedia

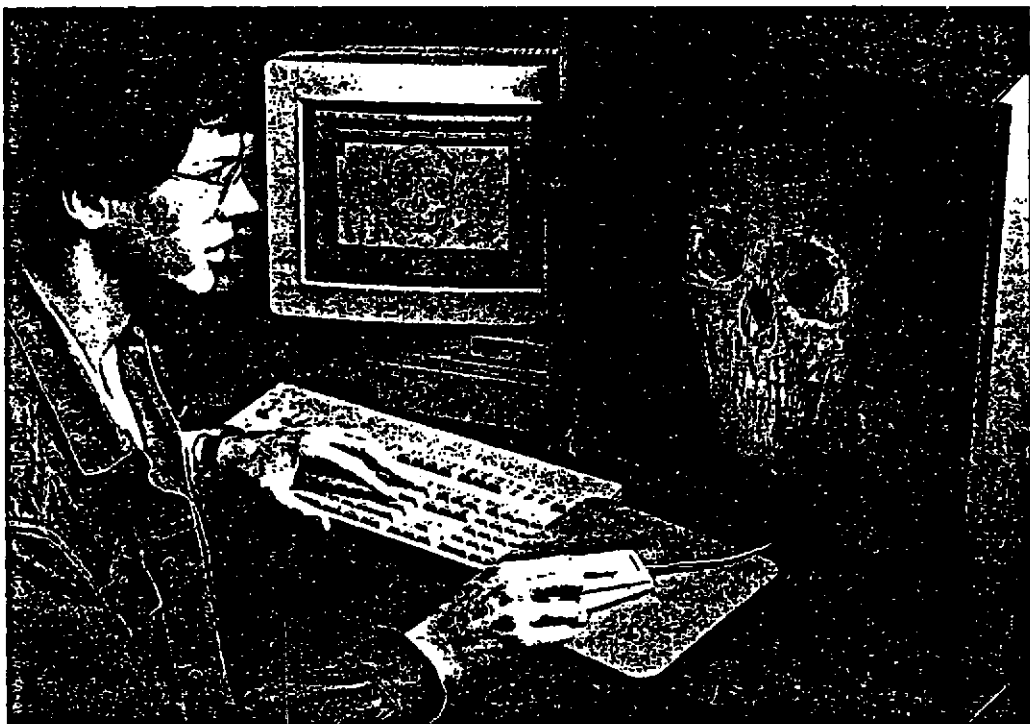
Stereo sound! Moving pictures! Endless data! It's computer heaven!

BY MICHAEL ROGERS

The time is the near future, and you're a student assigned to learn about ecology. But instead of plowing through out-of-date reports and badly drawn graphs, you're about to take a video adventure. You sit in front of two video monitors, a computer and a new hypermedia program from Lucasfilm. On one screen, an animated cartoon introduces Paul Parkranger, who invites you into his office. Meanwhile, on the other screen, a color film shows migrating ducks taking off from a lush green marsh. On the first screen, the ranger confides that the duck population is diminishing and he needs you to help find the reason. The evidence is in his notebooks and cabinets, on the screen in front of you.

Using the computer's mouse to move the on-screen image of a tiny hand, you "open" a file cabinet, take out a folder marked "Interviews." Suddenly the other screen fills with the image of a real farmer, talking about the ducks he's watched on his land. The cartoon file cabinet turns out to contain a dozen similar interviews with hunters, naturalists and game wardens—along with animated maps and articles about ducks. Using the mouse, you browse through the films, text and photographs, letting your curiosity lead the way. In the end, you fashion a theory of what forces are driving the ducks away. This simulates real life: there is no single right answer. But there is a process to learn and it's called thinking. Thanks to the new computer capability, that's one lesson students needn't overlook.

Hypermedia is here: a powerful blend of computers, video, photography and sound, already arriving on campuses and scheduled to reach homes late next year. From filmmaker George Lucas's California headquarters, where Paul Parkranger was created, to Cornell University Medical College



JAMES D. WILSON—NEWSWEEK

Alas, poor Yorick: A Stanford medical student uses the *Electric Cadaver* program

in New York, where students study anatomy on computer screens, researchers are developing a new medium which may transform education and entertainment as profoundly as has television. "The intensity of what you see and hear in hypermedia comes close to what you get in a film," says Stephen Arnold of Lucasfilm. "Only you can interact with it. It's a new kind of imaginary playground for the mind."

Command center: Hypermedia uses optical discs—big brothers of the compact discs used for music—to store not just sound but printed text, still photographs and motion-picture clips for replay on video screens. An optical disc can hold an almost unmanageable amount of information—tens of thousands of color photographs, along with enough text to fill a small library. And a new kind of computer software, called hypertext, organizes that data so that browsers move easily from subject to subject without needing an index or table of contents. In this system, the computer becomes a command center, controlling the optical-disc play and in-

stantly summoning whatever images, text or sound the user wants.

The results can be stunning. At Stanford University School of Medicine, for example, Drs. Steven Freedman and Robert Chase have created *Electric Cadaver*, a hypermedia anatomy primer that lets medical students move through thousands of anatomical photographs, from knee joints to the nerves of the face, simply by moving a cursor on a computer screen. By working with images, the student can manipulate a body in ways not possible with a real subject. For instance, a student can "paralyze" each facial nerve and, on screen, a small human face instantly shows the resultant drooping lip or canted smile. At Cornell University Medical College, an even more elaborate hypermedia system puts large color computer monitors right in dormitories. Among other things, students can use the system to review lecture notes, inspect X-rays or examine color photographs of organs. But those are only first steps. A student looking at a photograph of the liver can instantly summon up text

describing liver disease, then compare that with slides of liver biopsies, all on the same screen. "Hypermedia," says Dr. Daniel Alonso, a pathology professor at Cornell, "will fundamentally change the way we teach."

Hypermedia can also help reach students more familiar with visual images than the written word. At Lowell High School in San Francisco, teacher Patricia Hanlon and school librarian Robert Campbell worked with Apple Computer to develop a hypermedia accompaniment to John Steinbeck's "The Grapes of Wrath." Students read the novel, then sit down to a computer-controlled videodisc player, loaded with Depression-era radio programs, photographs, film footage and magazine articles (box). They can use the system to study dozens of aspects of life in America during the 1930s. Curious about the music of the era? The system will play a sampling of Woody Guthrie's songs. Interested in agriculture? The system can spit back crop yields, climatic conditions and nascent federal-aid programs. Never heard a fireside chat? Franklin Roosevelt is just a keystroke away. This is the ultimate research tool for a generation raised on television and stereo systems. "These students have been consumers of media," Hanlon says. "We want to let them become manipulators of media."

With hypermedia, the works of Shakespeare become user friendly. At Stanford, English professor Larry Friedlander uses computers to convert the text into a multimedia experience. At the end of a passage from "Hamlet," students can call up film clips of the scene on a video screen, occasionally freezing the action to consult the written text or switching among different performances for a moment-by-moment comparison. A click of the mouse replaces the original soundtrack with an interior monologue, suggesting what characters might be thinking as they speak their lines. To study the mechanics of acting, the student might ask to see "entrances": the monitor would display clips of entrances from Shakespeare productions.

Christmas tree: Hypermedia is evolving slowly. Broderbund Software Inc. is publishing a hypermedia version of *The Whole Earth Catalog*; when the catalog recommends a phonograph record, for example, it will also play a brief sample of the music. Random House will soon market a college biology textbook that offers, along with traditional lab manuals and study guides, an optional set of hypermedia discs. And the National Geographic Society is preparing a hypermedia geography tutor, which will link thousands of still photographs to maps of the United States.

Hypermedia players won't show up under the Christmas tree this year. A computer plus an optical-disc player still costs at

least \$3,000, so businesses and universities are likely to be the first customers. But next year, manufacturers such as Philips and Sony plan to introduce a new kind of compact-disc player which will produce hypermedia images and sound directly through home television sets. The projected cost of the player is under \$1,000 and more than a dozen publishers, including Time-Life Books Inc., Grolier and the Smithsonian Institution are preparing hypermedia discs for the new machines.

Problems remain for hypermedia. Not everyone even agrees on the name. Apple

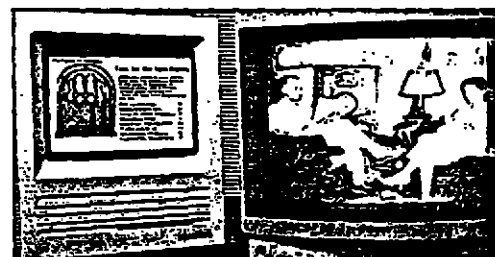
researchers prefer "interactive multimedia"; Sony and Philips have dubbed their home version CD-I, for Compact Disc Interactive. More important, producers are only now beginning to learn how to make the new medium easy to use. "Here are all these sights and sounds suddenly available," says Kristina Hooper, a senior Apple designer. "How do we make sure the user doesn't get lost in all this information?" Few researchers doubt the new medium's prospects. "It's like the early days of movies," says Lucasfilm's Arnold. "only we're already much further along." All that awaits is a really hyper D. W. Griffith.



Climbing the Vine

Grapevine, a hypermedia program, is a dazzling supplement to John Steinbeck's "The Grapes of Wrath." Below is one path a student might take through the course.

1 The computer (left) offers a selection of radio programs from the 1930s. The student chooses Franklin D. Roosevelt's "One third of a nation" speech, describing the plight of the nation's poor.



2 The video monitor shows a film clip of the speech, with historical notes on the left. When the clip ends, the student asks the computer to find more about the phrase "one third of a nation."



3 The path leads to a poster describing a Federal Theater production. On the left are study questions about government and the arts. The student asks to see more government-funded art.



4 The request yields a public mural from San Francisco's Coit Tower. From here the student could take various paths, ranging from newspaper clips about Coit Tower to a Woody Guthrie song.



PHOTOS BY ED KASHI



BY ERIC LUSE/THE CHRONICLE

Apple's Bernard Gifford (sitting) gave Ramon Cortines, S.F. school chief, a demonstration of the new tool

New Teaching Tool Unveiled

By Don Clark
Chronicle Staff Writer

San Francisco's 18 middle schools will be the first to try a new teaching tool for the TV generation, unveiled yesterday by the National Geographic Society, Lucasfilm Ltd. and Apple Computer.

The technology, based on a personal computer and a video disk player, brings American history to life with vivid video clips, historical pictures and maps, and even rap music. It lets students sort through and combine the material to research a topic, or even splice together their own video presentations.

National Geographic will sell the video disks and accompanying soft-

ware, called GTV, and plans to produce others in fields beyond American history.

"This is the culmination of the dreams many of us have had about harnessing the technology of the future in education," said Bill Honig, California's superintendent of public instruction.

GTV is one of the first important products in "multimedia" computing — one of the hottest buzzwords in high technology at the moment. The term is used to refer to the blend of conventional PCs with full-motion video, jazzy animations and stereo-quality sound.

Multimedia Computing Corp., a Santa Clara market research firm, this week released preliminary results of a

study that predicted the multimedia market for computers will grow to \$4.8 billion by 1993 from \$907 million last year.

Education and training are two of the most obvious markets for the technology, and GTV is regarded as particularly promising because of the prestige of its backers.

National Geographic, which has a massive library of education material from its magazines and TV specials, directed the effort, conducted the research and contributed film clips, 1,600 still images and 200 maps.

Lucasfilm, the well-known Marin film company, helped write the software and develop the visual effects

See Page B2, Col. 1

NEW TEACHING TOOL DEBUTS FOR THE TV GENERATION

From Page B1

and sounds. Apple created software tools and lent technical assistance.

The California State Department of Education contributed \$500,000 to the project. Apple and Pacific Telesis Corp. donated money to let each of the 18 San Francisco schools set up a mobile computer setup to play the GTV software.

During a demonstration yesterday, the GTV system explained historical episodes like the Great Depression, the Civil War and the Revolutionary War, with the use of narration, historical photos and music.

A piece called "Map Rap" showed how the United States grew through various wars and acquisitions.

Each image on the video disk is indexed and explained in text material displayed on the computer. The software also comes with a system for piecing together new presentations, by simply activating symbols with a mouse pointing device.

The approach is expected to particularly appeal to students who are so used to the pace and images of TV that they are bored in the classroom. "Children are engaged creatively," said Ramon Cortines,

San Francisco's superintendent of schools. "I believe our early adolescents will be excited about coming to school."

The first version works on Apple IIgs computers, but versions for the Macintosh and IBM-compatibles are planned.

George Peterson, director of educational media for National Geographic, does not expect to make money on the first GTV disk because of the \$2 million one-time cost in developing the software.

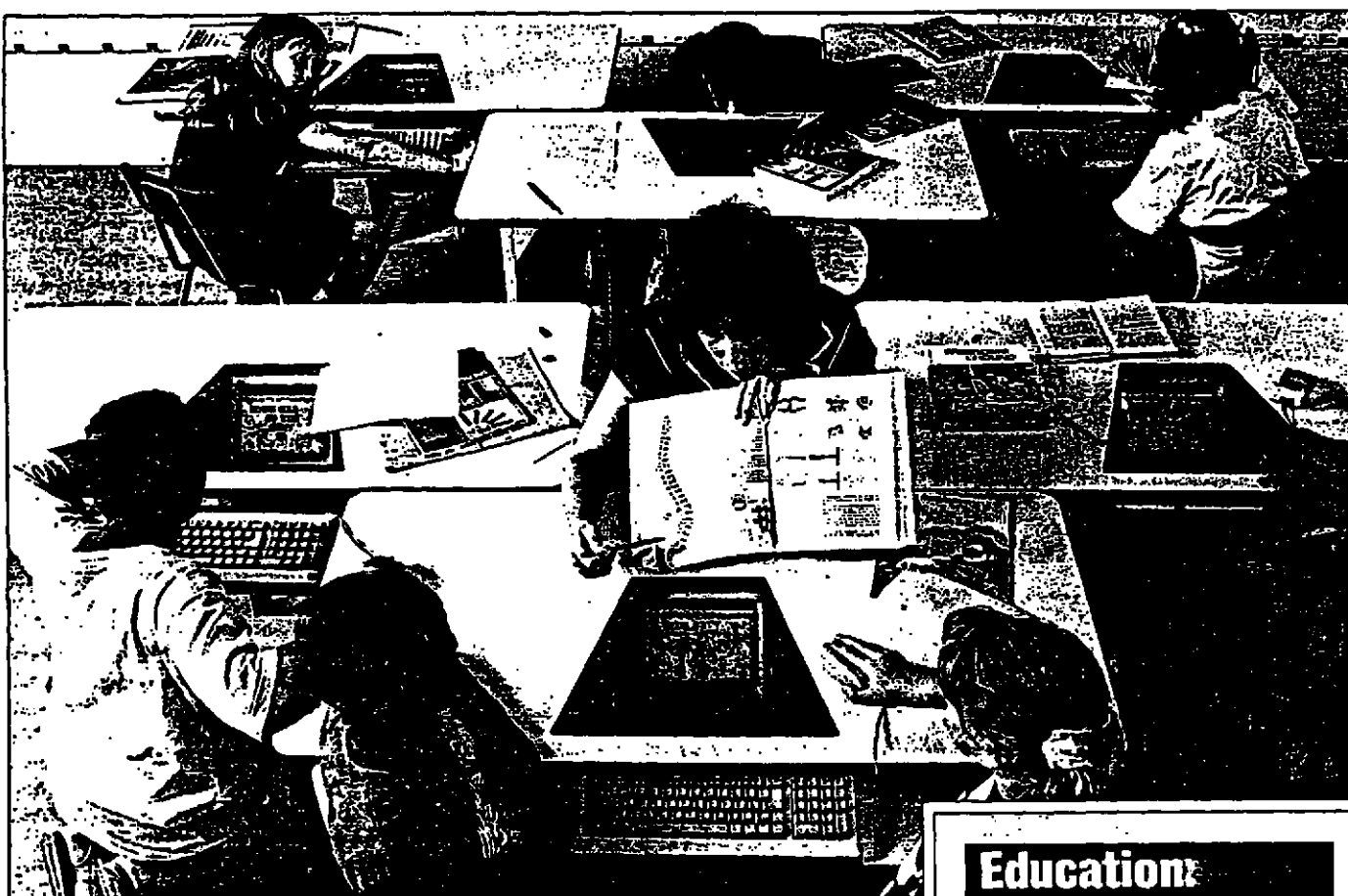
Cost to schools is another issue. The video disks and software start

at \$650, and more than \$1,500 in hardware may be needed.

"Many schools can't even afford enough books, let alone PCs and video disk players," noted Nick Arnett, editor of Multimedia Presentations and Computing, a Santa Clara newsletter.

But backers say technologies like GTV can win a sufficient share of state and federal educational budgets if they improve the quality and productivity of teaching.

"We don't have it now, but I think over the next 10 years that is going to be a major political issue," Honig said.



JAMES D. WILSON—NEWSWEEK

Friendlier teaching aids: *Learning biology in Apple's Vivarium project*

Computers of the '90s: A Brave New World

They'll talk, teach, play music—and take dictation

One April weekend in 1977 San Francisco's Civic Auditorium was filled with skinny young men at card tables selling circuit boards that, wired together, allegedly became personal computers. The machines stored data on converted audio-cassette recorders, displayed crude block letters on surplus television screens and printed on cannibalized electric typewriters. Few practical applications were in sight at the First West Coast Computer Faire—nor any indication that 11 years later one of the skinny young men would be back, just down the street at Davies Symphony Hall, with a sleek black computer that accompanied a symphony violinist and sounded precisely like a harpsichord. Steven Jobs has come a long way in a short time—but his

progress pales beside the breathtaking velocity with which the personal computer has evolved. And most remarkable of all: that evolution has only just begun.

A child of the next decade will be baffled and amused by the mute, colorless, passive and obtuse objects that today pass for personal computers. The computers that grace desktops and laps in that child's world will talk and listen; they will display full-color, lifelike images indistinguishable from photographs. Those computers will provide guidance through vast storehouses of information—from great books to daily newspapers to films and music and art. The sound of a harpsichord will be as natural a part of those future computers as a financial spreadsheet is for today's IBM PC. And none of this is rank speculation: while the

Education:

Grade school: Desktop computers will replace pens and paper.

Language: Voice simulation will make it possible to learn foreign tongues from mechanical tutors.

Libraries: Buildings full of books will be stored on optical disks.

Programming: Flexible software will make it easy for students to create their own computer programs.

exact details are anyone's guess, the computer of the '90s is already taking shape in research centers around the country.

The NeXT machine, which Jobs unveiled last week at Davies Hall, blends most of the key elements that will make that future happen. Technically, it belongs to the class of computers known as workstations—a prosaic name for the most exciting hardware now sold. Workstations combine high-power processors, vast amounts of memory and the ability to communicate seamlessly with other computers. They are the hot rods of today's computer world—costly and hard to drive but capable of extraordinary speed. Already, off-the-shelf personal computers from companies like Apple and Compaq are achieving workstation performance—even as workstations

are dropping in price. By the mid-'90s, today's \$20,000 powerhouses will become mainstream desktop appliances, far easier to use than today's computers, sold in retail stores or by mail for less than \$3,000. The power of a mainframe computer will fit on any desktop, along with enough memory to record an entire library of books. The computer will have finally come of age—but what will we do with all that power?

There is zero doubt," says Nick Donofrio, vice president for development of IBM's entry-systems division, "that the computers of the future will be more user friendly."

In fact, as much as 50 percent of the added power of tomorrow's computers will go to make the machines easier to use. The "graphical interface" popularized by the Apple Macintosh (in which symbols such as a trash can replace commands such as "delete") will become a standard feature; chances are good that the once controversial "mouse" will also become the universal tool for navigating across the computer screen. Computer makers will vie to make their machines visually pleasing and fun to use, but that's just the start. Along with visual cues, computers almost certainly will develop their own voices.

Chatty computers have been possible for years, but the technology has been expensive, the applications limited. Early on, marketers realized that an office filled with computers jabbering away in mechanical tones would be a tough sell. But with their new power, computers can now produce very pleasing human voices, complete with Texas drawl or sultry intonations. And sometimes talk is useful. Future computer programs will probably coach novice users by talking them through complicated procedures: "To erase that word, hit the backspace key. No. Not that one, the one next to it." And travelers may be able to dial their computers from the road and hear the day's electronic mail read aloud.

Computers will begin to understand speech as well, although that's proven far tougher than mimicking a regional accent. One of the best speech-recognition systems thus far, developed at Carnegie Mellon, can understand about 1,000 words of English spoken by anyone. Computers that have been "trained" to understand only one voice can manage a much wider vocabulary—although most experts agree that the dictation-taking computer is still a decade away. Jobs—whose NeXT computer will someday offer voice-recognition software—suggests that to ensure security and privacy, future computers may turn on only when they hear the sound of their master's voice.

Talking computers may find their warmest welcome in university language labs. Computers are already important tutors:

"My prediction," says Frank Ryan, director of Brown University's language lab, "is that in no more than two years, all the grammar taught in our French classes will be taught by computer." But that's just a start. Brown, Dartmouth, MIT and Stanford are all exploring even more ambitious ways to put computers to work in language instruction. One current program shows computer-controlled film clips of French or Russian speakers shopping or going apartment hunting; the on-screen speakers regularly pause to ask questions. The student responds by typing an answer that the computer either accepts or corrects. Once computers can speak fluently, however, the computer itself—rather than taped humans—will interact with the student. Language teachers expect to have computers that will read, with correct pronunciation, each sentence a student types—even using Chinese or Russian characters.

Friendlier computers will transform grade schools as well. A recent Office of Technology Assessment study concluded that modern classrooms are far less computerized than offices or factories. Part of the reason is limited funding, but overburdened teachers also resist the added hassle

of bulky and inconvenient hardware. Simpler computers will mean that both teachers and kids can begin to use them as daily tools rather than special-purpose drill-and-practice machines. At The Open School in Los Angeles, an Apple-financed research project called Vivarium aims to make computers as natural a part of the curriculum as pencil and paper. Computers are recessed under the desks but are visible through transparent desktops—out of the way, yet always accessible. Last year, says Apple research fellow Alan Kay, 300 kids, some as young as five, learned a program called Hypercard. Kids use it to do their homework, take class notes, make drawings, even create data bases, on easy-to-use software. "Children are very good at computers," he says, "and computers make the kids look and feel smarter."

The physical shape of computers will become friendlier as well. They'll almost certainly shrink; already, you can buy a laptop computer as powerful as an IBM desktop machine that will fit in a 9-by-12 manila envelope. New flat-screen displays from Japan are so sharp and crisp they appear almost like a sheet of paper; within a few years such screens will be the equal of bulky cathode-ray tubes in both color and clarity. Apple's Kay says the portable computer will be so compact and convenient that owners will even make their grocery lists on it and then carry the machine along to the store. Mitch Kapor, founder of Lotus Development Corp., believes some computers will lack keyboards altogether; owners will hand write their thoughts on a small tablet. Further out, says Andrew Lippman of MIT's Media Lab, computers may even be sewn into clothing. "Maybe we'll have

Business

Design: Everyone from architects to dressmakers will be able to make simulations of products—in 3-D.

Secretarial work: Machines will take calls, write memos and organize the busiest of executive schedules.

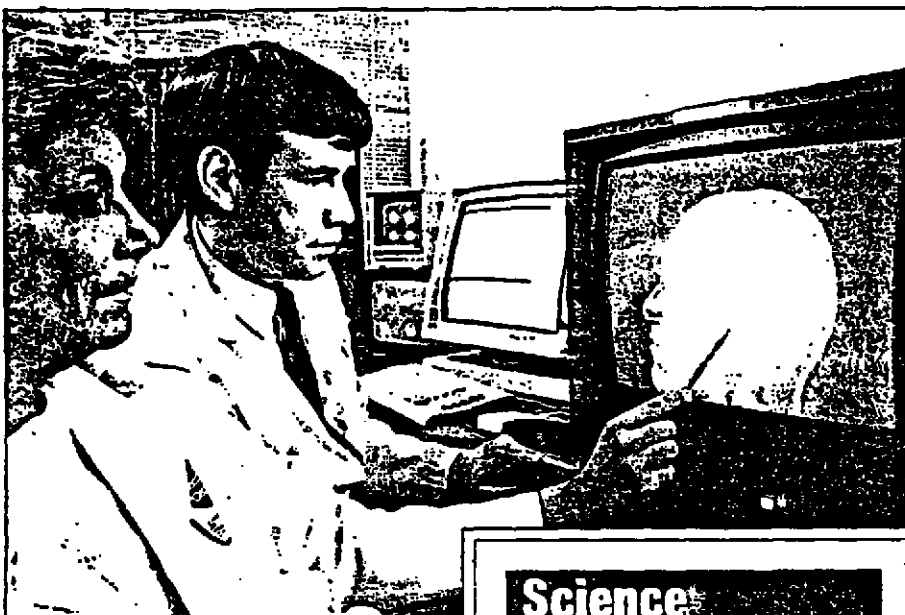
Networking: Using groupware, machines will talk with each other.

Travel: Laptops will be small enough to slip into a vest pocket.



JAMES D. WILSON—NEWSWEEK

Picture this: A designer at Levi Strauss creates fashions with the click of a 'mouse'



DAN MCCOY—RAINBOW

Brain scan: Inspecting a 3-D image

computational jackets," he says. "They'll whisper in your ear." Regardless of form, says Apple VP of advanced technology Lawrence Tesler, one thing is clear: "Sooner or later, more people will carry their computers around than keep them fixed to a desk."

Paradoxically, the more powerful a computer, the easier it is to write simple software programs: the computer, in essence, takes care of the little tasks, such as remembering your favorite typeface, that you once did yourself. In fact, software can be made so simple that computer owners can modify programs to their taste without knowing anything about bits and bytes. "Our whole interest," says Apple's Kay, "is letting ordinary people make tools for themselves. In the future you'll get an application out of the box and, after a couple of weeks, you'll have some ideas and change it." With business software, you'll be able to create a sort of helper-secretary with just the abilities you need. If you need to take notes during telephone calls, for example, you might tell the program to automatically bring up a fresh screen, ready for typing, each time it hears the phone ring. John Seely Brown of Xerox's Palo Alto Research Center calls these "glass box" computers, whose software workings are so clear that the user understands exactly how to modify it for best results.

Living within the powerful computers of the '90s will be a new cast of characters called "agents," programs that take advantage of the computer's ability to complete more than one task at a time. For instance, when you're writing a letter on screen, the agent can still do something else off screen,

Science

Medicine: Doctors will walk through surgery beforehand—on a screen.

Technology: Sophisticated imaging will revolutionize high-tech design.

Meteorology: Computer "models" will track weather patterns and predict major shifts far in advance.

Criminology: Police will be able to re-create the scene of a crime—and simulate the moves of the criminal.

You might ask an agent to make an airline reservation for you, cheapest fare, before noon, next Thursday; then, while you return to your immediate business, the agent will dial an on-line travel computer, sort through the possible flights and pick the best one for you. Similar agents could check your daily bank balance and warn you if your funds are getting low, or sort through news and financial data bases and bring back reports customized to your interests.

The biggest change in computers will also be the most visible. All computers will someday provide color screens capable of producing realistic moving graphics with the illusion of depth. Already engineers and scientists use such systems for designing aircraft or modeling weather patterns. Similar systems at affordable prices will mean that any architect, for example, can design a building, then have the computer generate an actual on-screen "walk-through" of the structure to see how light falls. An interior decorator will use a similar computer to create on screen a room filled with furniture; then—with the touch of a key—change fabrics and wallpapers to try out different looks. The FBI has even consulted the MIT Media Lab for ways to use powerful graphic computers, perhaps

to re-create crime scenes. James Clark, chairman of Silicon Graphics, which just introduced the first 3-D color workstation for less than \$15,000, says his firm is developing an "out-the-window display." Turn the computer on and the screen will seem to disappear—it will appear as if you're gazing out an office window, seeing leaves on the trees, the texture of grass and brick, even reflections off the sidewalk. Then, of course, it's time to get back to work.

High-quality graphics will also finally turn computer games into mainstream entertainment. When it comes to competing with movies or video cassettes, says Trip Hawkins, president of Electronic Arts, "today's computer is like the telegraph competing with the telephone." But that's soon to change. Hawkins describes today's shoot-'em-up space game, as interpreted by the technology of the mid-'90s: "The game would start with a terrific stereo sound track, like a science-fiction movie. Then you'd blast off, with realistic animated sequences, in full color, on screen, as if you were looking out the window of a spaceship. When you landed, you'd meet aliens, in 3-D and full color, who would converse with you in their native tongue." And at that point, presumably, you'd say, "Take me to your leader." They'll pull out their stun guns. And the game is on.

The flashiest innovation in Jobs's NeXT computer is its "erasable optical disk," which uses a laser beam to record immense amounts of information—the equivalent of 400 books—on a single \$50 plastic cartridge smaller than a paperback book. Jobs's machine will soon be followed by others—everyone from Apple and IBM to tiny Silicon Valley start-ups has an optical disk in the works. The payoff is big: computers equipped with optical disks are able to store and manipulate information in a variety of forms—not just text, but photographs, moving video and stereo sound.

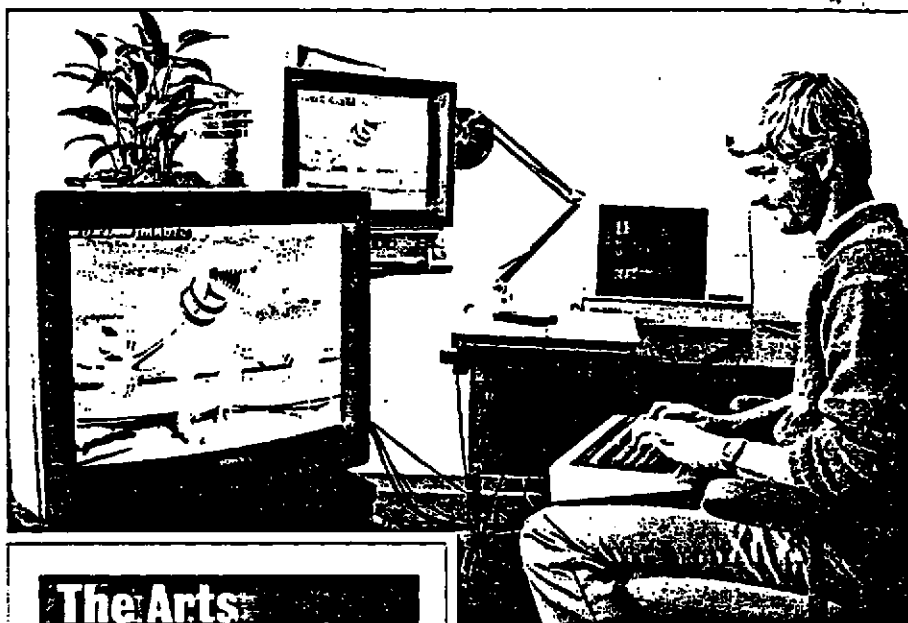
Optical disks will soon affect universities, where information storage is big business. Peter Lyman, director of the Center for Scholarly Technology at the University of Southern California, says his school's new library, to be completed in 1993, is likely to be vastly different from today's version. He expects that the most used books will reside not on shelves but on optical disks; students will call up text on computer screens and use high-quality laser printers to produce pages to take home and study. Someday students will even access the library stacks directly from computers in their dorm rooms. And not just books: Lyman foresees a library in which slides, movies, music and art can all be summoned up for viewing on the same computer screen. Students may still want to go to

the library, however, for social purposes.

Optical storage isn't just a way to save space on your bookshelves: it also offers an entirely new way of searching through printed material. At the unveiling of NeXT, Jobs pretended to be a student trying to recall a Shakespearean quotation, but only able to remember that it contained the word "brooks." By asking the computer to search for "brooks," Jobs was almost immediately presented with the right quotation—plucked from the entire body of Shakespeare's work which is included in NeXT's memory. At Brown, the Intermedia project takes the search function a step further. A student studying Alexander Pope, for example, can use the computer to follow a trail of information describing everything from Pope's work to the house he lived in to samples of the writings that influenced him.

In the future, no computer will be an island. Personal computers will all be able to communicate with one another over telephone lines and specialized networks built into offices and schools. "Most work is collaborative in science and industry," says Wayne Rosing, vice president of advanced development for Sun Microsystems. "It's a waste to have hundreds of computers in a building that share nothing but AC power." But that won't be the case for long, and once computers are connected, experts predict a new class of software: "groupware." Groupware will permit an officeful of people to collaborate on, for example, a magazine advertisement, with artists, copywriters and salespeople all contributing, via computer, to the project. When a writer changes a line of copy, it will instantly show up in the layout on the designer's computer screen.

Groupware will change the way work is done. Already firms are testing calendar systems, for example, that automatically set up meetings, by going through the network to ask each person's computer when the individual has free time, then choosing the optimum meeting hour for all concerned. Such systems can even "know" that if the schedules of boss and underling conflict, the underling has to rearrange. Computers will change meetings themselves. Brown of Xerox envisions meetings at which every participant has a computer—and the meeting's progress appears on a "decision spreadsheet" projected on one wall, on which the pros and cons of the argument are analyzed for all to see. Mitch Kapor imagines a future office-computer screen that includes a little water-cooler symbol: click on the water cooler and you're connected to similarly inclined workers for the electronic equivalent of chatting at the office water cooler. Why not just walk down in person? The networked office of the future may well include work-



ROGER RESSMEYER—STARLIGHT

The Arts

Graphics: Any artist will be able to do supersophisticated animation or create images that look real.

Music: Compositions will be written and stored on computers.

Video: High-resolution screens will revolutionize the field.

Games: Home computers will be able to generate sounds and special effects of a "Star Wars" movie.

Special effects: A display of animation

need to build a national infrastructure that will be the information equivalent of the national highway-building of the '50s and '60s," says Kapor. Not everything will move through wires. Alan Kay expects that portable computers will require built-in cellular-telephone connections—so you can tap into big data banks while sitting under the apple tree. But those data banks themselves still need work: most of the books in the United States are available only on printed paper, and it will require a huge investment to turn them into the digitized information usable by computers. Publishers have yet to solve the copyright problems involved in paying authors whose books are delivered electronically rather than in bookstores.

The problems are substantial, but so is the enthusiasm to overcome them. From Silicon Valley to Cambridge, Mass., there is a sense that the personal computer is on the cusp of a transformation as radical as its very invention a decade ago. Ironically, the computer may well change into something essentially different—a blend of telephone and television, perhaps, that functions more as communications tool than as word processor or number cruncher. "It may be," says Xerox's Brown, "that the personal computer disappears off the desk and into the furniture: you'll have computational file cabinets, blackboards, telephones." Apple's Tesler agrees: "The ultimate fate of the computer is to fade into the background—to be everywhere." At that point, the computer revolution will have succeeded beyond the fondest fantasies of those garage-shop tinkerers who started with only soldering irons and dreams.

MICHAEL ROGERS with
RICHARD SANDA in Cambridge

ers in a half-dozen cities, separated by thousands of miles and a couple of keystrokes.

Optical disks, talking computers and even electronic water coolers already exist. The question remaining is how quickly they become commonplace. Some major roadblocks remain. For starters, the computer industry may find itself mired in its own success. Millions of computers have already been sold and still work perfectly well—although they will never run optical disks or produce lifelike color graphics. Will owners trade up for those extras when their existing machines run fine? Computer manufacturers hope that the new machines will prove so attractive that current owners won't want to wait. Instead, a hand-me-down pattern may emerge: in large companies, for example, current computer users will go on to the new machines and workers who don't have computers at all will inherit the older hardware.

A more serious problem is that many of the computer dreams depend on flawless, high-speed communications between computers in the home or office and the outside world. Future computers will require powerful information conduits to provide their rich diet of data, sound and images. Current telephone lines won't be enough. "We

TABLET: Personal Computer in the Year 2000

B.W. Mel, S.M. Omohundro, A.D. Robinson, S.S. Skiena,
K.H. Thearling, L.T. Young, S. Wolfram

Communications of the ACM
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TABLET: PERSONAL COMPUTER IN THE YEAR 2000

BARTLETT W. MEL, STEPHEN M. OMOHUNDRO, ARCH D. ROBISON, STEVEN S. SKIENA,
KURT H. THEARLING, LUKE T. YOUNG, and STEPHEN WOLFRAM

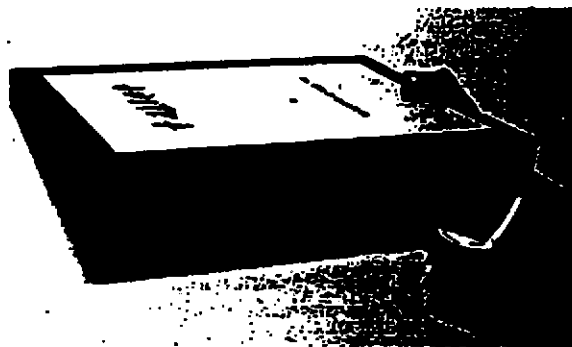
A design represents a compromise between conflicting goals, and the design of the personal computer of the year 2000 is no exception. We seek something that will fit comfortably into people's lives while dramatically changing them. This may appear to be a contradiction that cannot be reconciled. But if the technology does not fit easily into the habits and lifestyles of its human users, it will be discarded by those it was meant to help. And if this new tool does not change the life of its owner, it is only because we have been too shortsighted to imagine the possibilities.

Our way out of this dilemma is to base the design upon something which is already integrated into everyone's life, to take a vital tool and give it more life. We have chosen to improve something that most people use everyday, the humble paper notebook.

We have all heard the computer revolution was supposed to eliminate paper from the workplace. Instead, it has led to desktop publishing; now we can not only write papers but typeset them ourselves. Paper notebooks have many properties that make them particularly friendly. They are light and portable. No one thinks twice about taking a pad anywhere. They are easy and natural to use, as accessible to the toddler as to the octogenarian and as relevant to the artist as the engineer. They can be used to communicate with other people. They are the ideal medium for integrating text

and graphics, and perfect for creative doodling. Moreover, notebooks are forgiving of mistakes, simply peel off the page and start anew.

It is natural to revise and edit written documents. There is something satisfying about crossing out an offending sentence from a written draft, a feeling that word processors have not captured. We aim for a computer that will provide all of these benefits and more.



Thus, the personal computer of the year 2000 will be a portable machine the size of a notebook. We will write and draw with a stylus on a screen which mimics a physical writing surface. Enhancing this with the powers of computation and communication, we create a tool that will improve the way we live and work.

This report provides a more concrete depiction of the machine we have in mind, namely TABLET.

© 1988 ACM 0001-0782/88/0800-0639 \$1.50

THE MACHINE

Our machine will have the same dimensions as a standard notebook. It will look like an $8\frac{1}{2}'' \times 11''$ monolith from the movie *2001*, and be reminiscent of Alan Kay's *Dynabook* [9]. This rectangular slab will weigh but a few pounds, and have no buttons or knobs to play with. The front surface will be a touch-sensitive display screen and will blink to life upon touching two corners. On one of the short sides will be a credit card sized slit, while the other three sides support a ridge with a slight reddish tint. TABLET is targeted toward the professional of the year 2000 who is willing to pay the equivalent cost of a microcomputer of today.

The I/O Surface

The most important part of any computer is its interface with the user. The front surface of our computer is a high-resolution touchscreen that yields slightly to the touch. With this single input device, we can get a tremendous range of flexibility and options. We can use it to create an entirely soft interface.

Fingers are low-resolution devices. They can get in the way in certain applications, especially when they block our view of what they point at. To take true advantage of human motor control and a high-resolution touchscreen, we need a fine-tipped stylus. A walk through any art gallery shows what a person can do with stylus type devices.

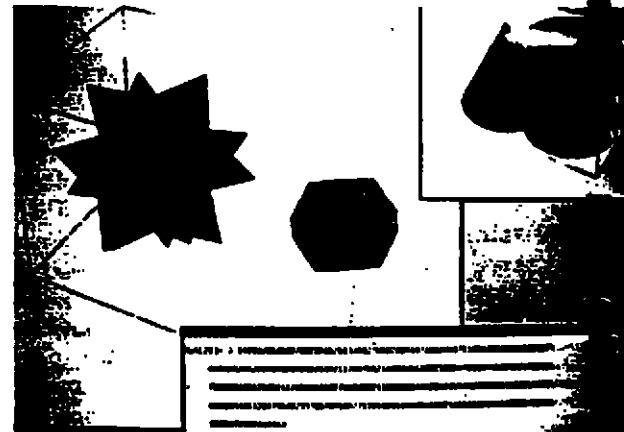
On powering up our machine, icons representing a typewriter keyboard, a ballpoint pen, a telephone, a calendar, a TV, and a host of other applications will appear. By touching and dragging with the stylus, we can manipulate the icons as with a mouse. We can move rapidly through a series of popdown, drag-off menus by checking off what we want with the stylus. Pressing the typewriter icon will cause a keyboard pattern to appear on the screen. This pattern can be redrawn like MacPaint objects and thus be customized to the user's finger size and taste. Since it is soft, the key pattern can be QWERTY, Dvorak or based on one of the new, non-standard shapes like the chord. As we traverse down a menu and need text input, the keyboard will appear.

But if we are holding a stylus, why bother with the keyboard? Unless the user requires rapid entry, the stylus is a natural way to enter text. Pressing the ballpoint pen icon will cause a ruled notebook page to appear on the screen, complete with simulated looseleaf holes if desired. With the stylus, we can write and draw directly on the surface of the screen. As we stroke the stylus across the screen, a simulated ink trail is left behind. Nothing beats a pen for writing or drawing, so this will permit the ultimate integration between text and graphics. Some people feel more comfortable composing on paper than on a computer, and this method presents the illusion they are. And, if we wish, handwriting recognition software will convert to type all the text we scrawl out.

This metaphor will extend easily to the applications with which we are familiar. Text editors can be built

around the standard editorial symbols used by proofreaders, where slashing out a word deletes it and swapping two words transposes them. Despite the interactive nature of word processing programs, almost all writers print out a draft and scratch corrections upon it before pronouncing it ready. Our text editor will support this style, and graphics and mathematics will be integrated in a similar fashion.

Without question, this is technologically feasible. Our interface relies on three different technologies: display, touchscreen, and optical character recognition. Each of these areas is progressing nicely toward what we need in 2000. The density attained in liquid crystal display (LCD) technology has increased by a factor of 100 over seven years [8]. For an $8\frac{1}{2}'' \times 11''$ color display with laser printer resolution we need less than 3×10^7 pixels, which by extrapolation will be available by 1991 and cheap by 2000. In addition, LCDs represent the perfect foundation for a touch-sensitive display. The capacitance of an LCD cell is pressure sensitive, so it can easily detect the tip of a stylus and even how hard it is being applied. LCDs have already been used as digitizing tablets [14], and given the resolution of our display we will have no difficulty mimicking the fine ballpoint.



Cursive character recognition is a difficult problem, and smacks of artificial intelligence. However, there has been enough progress to show that it is coming. Today, there exist systems with 97 percent character recognition accuracy rates for neat handwriting. Combined with spelling correction, such systems achieve near 100 percent accuracy [15]. Adjusting for variation in handwriting is equivalent to breaking a substitution cipher [3, 12], a trivial task for our computer. Training the machine to recognize the owner's handwriting will lead to the highest possible recognition rate. Of course, no system will recognize 100 percent of handwritten text, but what is not recognized can be highlighted in a different color and reentered by the user.

A high-resolution color display can do more than imitate a notebook page. It will be fast enough to support video. The entertainment possibilities are amusing, such as having a display of $361'' \times 1''$ moving icons.

each one a different television channel, permitting us to monitor the action over a large section of the dial. We can watch the bad guy being rubbed out on Channel 6 while the passion heats up on Channel 40. A more important application is video communications. Video is the next obvious step in the communication evolution which started with text and has progressed to voice.

It might seem surprising that our design is not built around speech recognition as the major input technology. Science fiction seems to specialize in talking to computers and listening to what they say. However, people do not really want to talk to computers. In many of the contexts where a portable computer will be used, such as the classroom, the airplane, or a shared office, talking out loud is not acceptable behavior. Further, dictating letters and memoranda is a skill which takes time to master, and is something that makes most people uncomfortable. Our handwritten interface is much less intrusive than speech.

The LaserCard Mass Storage Units

The high density read-write storage card unit represents the next milestone in mass storage technology. Replacement of the classical rotating disk/movable head format will result in spectacular improvements over current mass storage systems in terms of data capacity, data rates, and integrity of physical construction.

These credit card-sized optical RAMs will be a convenient, inexpensive, and physically robust data storage medium. People will carry them in their shirt pockets and trade them like baseball cards. "Can I borrow your reference library, please?" Customized cards will be ordered from information services via electronic menu-driven catalogs, offering a wide variety of books, video and data, all paid for by the gigabyte.

The vast storage capacity of *LaserCard* devices will alter our conception of what should be stored on a computer. Through data compression techniques, a single one-gigabyte card will hold four hours of video or two thousand books from a personal library. Current optical media are limited by the resolution at which a laser can be focused, currently approximately one square micrometer, and require a head that sweeps back and forth mechanically over a rotating disk [11]. Advances in high-resolution optical films (such as LCDs) will allow the fabrication of huge arrays of independently addressable "light-gates," that can be used to direct the beam of a short wavelength, solid-state laser directly onto a specific site of the storage medium for reading or writing. The surface-emitting lasers will be paired with photo-detectors, in a relatively low-density grid positioned above the optical gating system, defining a set of independently read-writable "laser" sectors.

This technology will have no spinning disks, no servored read-write heads, and no rotating mirrors. The only moving part in the whole machine will be the lid which keeps the optics dry if we use it in the rain. Because of its size and durability, the *LaserCard* will be an integral component of a powerful portable machine.

The Infrared Interface

Along three sides of the box will be an infrared bar interface. This is how we will connect our machine to its immediate surroundings. What might we want to connect it to? Printers and projectors, stereo headsets and video cameras, toasters and roasters, and just about anything else. Microprocessors have already become inexpensive enough that many household items are now "smart." Smart devices are most useful if they can communicate with other smart devices. Using a 256-bit key, we can give every atom in the universe a unique identification number, let alone give every separate memory location in each smart device its own unique ID. Thus, when devices talk to each other, they will know to whom and to what they are speaking.

On clipping a device to the bar, the computer and device will start to talk to each other at near gigabaud rates via infrared [13]. The device can be identified, causing the appropriate icon to appear on the screen. An advantage of using infrared light is that devices need not be physically clipped on while indoors. When the user is within the reception area of the printer, the printer icon will appear. There is a tradeoff between dispersal and bandwidth with infrared, and trouble occurs when the scattering delay approaches the distance between bits. Clip-on lightguide cables will be necessary to achieve data rates above 500 kbits/second, and infrared repeaters stationed in large offices will improve accessibility.

What types of peripherals will people need? One of the most widely owned peripherals will be a tactile keyboard. For rapid text entry, nothing beats a good solid keyboard. The fastest recorded human information transfer is music pouring out of the fingers of a concert pianist. The handwriting interface and simulated keyboard will suffice for portable applications, enough so that we will not want to be hampered by the dead weight and fragility of a keyboard when we are on the move. But it would be nice to have a real one for some applications and why not? When we move our machine within infrared range of our keyboard, a typewriter icon will popup on the screen, which we can open and then start typing.

Another peripheral that will be extremely popular will be a lapel-sized video camera. Charge-coupled devices (CCDs) make inexpensive and rugged solid-state cameras. As with LCD, CCD production methods are similar to VLSI, and prices will follow the corresponding learning curve. The upshot is that camera devices will be so inexpensive most people will be able to afford one. They will be useful for recording meetings, self-recorded e-mail videos for instruction and personal communication, and as a digitizing device for printed documents that remain in the year 2000. The notion of digitizing documents is important because a substantial number of printed documents will remain, such as old books and new contracts. After digitization, the image can be processed to cleanup and recognize the text. Imagine not only carrying a Xerox machine, but one that will permit the user to search xeroxed documents by keyword and context.

It takes only a little more courage to predict a Global Positioning System (GPS) receiver on our machine, either as a clip-on or a built-in component. GPS [6] is a satellite-based positioning system which enables objects to determine their location in the world to within a few meters, or even closer if the U.S. Department of Defense allows it. By plugging in the *Rand McNally Road Atlas LaserCard* and taking our computer for a drive, it can provide us with an ideal route between two points by considering the possible routes, the time of day, and current traffic patterns (using an on-line data base, discussed below). The capacity of a *LaserCard* is such that we can store all the parking spaces in the state, and have the best spots near that French restaurant in the city read to us through a speech synthesizer.

In addition to communicating with peripherals via infrared, we can also talk to other computers. Each machine can continually broadcast personal facts that users may wish the world to know: perhaps their name, image, interests, and marital status for openers. Setting a machine in "get acquainted mode" will display the location of all machines in the vicinity and list the names of their owners. While sitting on a plane the user can scope the crowd, and maybe find someone interesting to talk to during the trip. Just imagine turning this loose in a singles club!

The DataLink

If we can take our computer anywhere, we need to be able to use it anywhere. This brings us to communications capabilities. Through our national telephone network, we can access any person or machine within seconds. Historically, this depended upon direct physical connection with the phone grid. Cellular telephone technology has changed all this and will change personal computers as well.

What can we expect from cellular telephones? Clearly voice communications, but more important for our purposes will be data. Cellular telephones supporting the ISDN standard will transmit approximately 56 kbits/second for each of 400 users per cell. With compression, this is sufficient to transmit video at conference quality rates today [7] and will increase performance dramatically with new adaptive algorithms.

To use this link for voice communications, we will need a microphone and speaker built into the unit. These are inexpensive and justified by other applications. However, for privacy, in most applications we will use a headset attachment clipped onto the infrared bar.

The main use for the cellular link will be to communicate with other computers and the people using them. Electronic mail is a wonderful medium for ideas and does not intrude upon the recipient the way a telephone does. It sits there quietly waiting to be read. We will be able to integrate video and graphics as well as text in our e-mail documents. It will also improve more traditional forms of communication. Filters can be used to eliminate unwanted junk mail. This will alter the face of advertising. Future advertising will be

done by subscription—users wanting to keep up with new cars will let the industry know.

Finally, TABLET will be welcome news for romantics. The touchscreen and cellular link will conspire to transmit handwritten love letters anywhere in the world in seconds.

The Traditional Computer

The aspect of our design which deals with what today is described as the computer, i.e. the processor and memory, is rather mundane. It is clear there will be mega-MIPs and giga-bits available to work with, but since our machine is intended to be a commodity, the speed will not be a constraint. This is not to say we will fail to exploit whatever computational power we can get, but nothing we foresee needs more power than is granted us by very conservative projections [10]. Whatever processor we have under the hood is irrelevant to the rest of the design. Thus, we avoid the temptation to guess the exact number of MIPs or the memory size of our machine. We also avoid citing exactly how many processors the machine will have. There will obviously be some form of parallelism, in the tens of processors rather than the thousands, several of which will be special purpose devices for graphics, image compression, and analog signal processing.

One would hope that from all the attention focused upon instruction sets in the RISC versus CISC debate, a standard instruction set for general purpose computers will be established by the year 2000. Odds are it will be quite RISCy, and this will permit object code compatibility across a wide range of computers. There is really not a significant difference between the instruction sets of different manufacturers, and enough of them have been burned producing incompatible chips for the industry to lead the push for standard processors. Microprocessors will be pretty much generic, coming in fast, extra fast, and economy sizes. This degree of uniformity already exists with memories and will drift to more sophisticated components.

There will also be standardization among user interfaces, to the extent that all will be constructed in layers, where all but the highest layer will be a universal standard. Running on these generic processors might be a standard version of UNIX, appropriately updated for parallel architectures, which will come out of its shell into a standard Postscript interface. Other hardware standards, like the RS-232 interface and MIDI will be simulated over the infrared-bar interface.

What will these processors be made of? Most likely, silicon because of the accumulated manufacturing experience. The only gallium arsenide in TABLET will be in the infrared bar interface for the LEDs. More exotic technologies such as optical computers, molecular or chemical computers, or superconductors will not mature by that time. Currently, we are only a few years and few orders of magnitudes away from some fundamental limits on feature size in silicon. These will essentially be reached by the year 2000, and so research will change direction toward more reliable processing

and higher yields. This makes possible wafer-scale integration with all the circuitry sitting on one six-inch diameter wafer. Putting both memory and processor on the same chunk of silicon will improve performance by reducing buffering and capacitance delays. There will be so much room on a wafer that there will be at least two of each functional unit onboard, dramatically improving yield and reducing costs.

Between improvements in semiconductor processing and improvements in design technology, the complexity of IC's should continue to quadruple every five years [1]. With generic processor architectures and room for a wafer full of circuitry, what will there be for the new generation of silicon compilers to do? Crank out special purpose processors, no doubt. Traditionally, co-processor chips were used because there was not room on the chip for the arithmetic or graphics hardware. Now, there will be room for a larger graphics processor, analog and digital hardware for image processing, and much more.

Perhaps the most interesting special purpose processor will be a general adaptive data compressor sitting between the memory and the main processors. It will be a hardware implementation of an adaptive algorithm such as Lempel-Ziv [18] or LZW [16], or perhaps some higher level algorithm recognizing features in text and video. This will permit video to be stored on *LaserCard* and transmitted over low bandwidth lines, because image expansion will occur at video rates. If a picture is worth 1,000 words, imagine what can be saved by image compression. Through compression researchers have already fit 72 minutes of video [2] on a CD-ROM, which is about half the size of our projected *LaserCard*. This same technology will be essential to transmit video over the cellular phone link. It is ironic that compression becomes even more important as memory size increases because there is so much more to transmit and access.

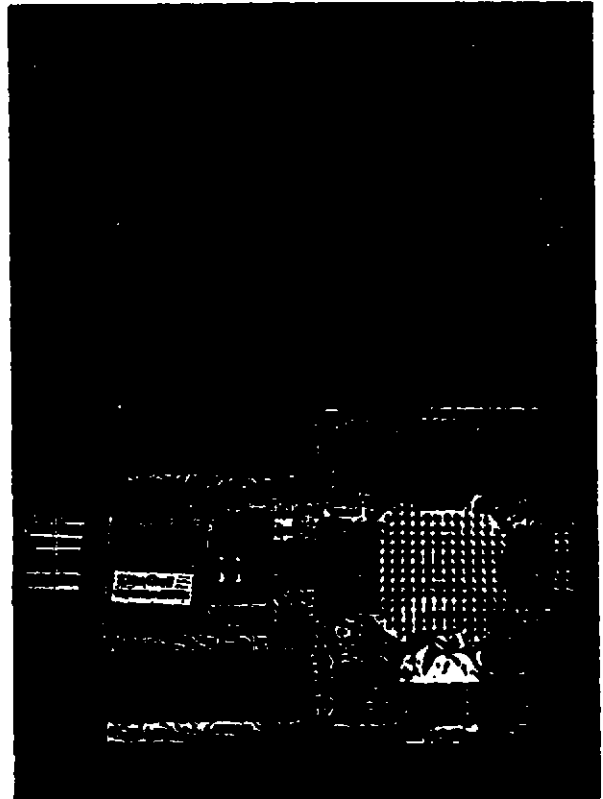
Power

TABLET is designed to bring power to its users. With a portable computer, however, the user must bring power to the machine. Either the machine must contain its own power source, or it must take energy from its environment. The only significant power from an indoor environment is light, but we can expect no more than 0.3 watts even if we cover the entire surface of our box with efficient but ugly solar cells. Fortunately, recent developments suggest we can plug into battery power.

Lithium battery performance has approximately doubled each decade since 1946 [4]. Already, lithium D-cells can deliver 45 W-hr. This provides all the power we will be able to use without running into heat dissipation problems. Rechargeable lithium batteries exist, and one way to recharge them will be with inductive coupling. Park the machine in a holster plugged in an electric outlet and the batteries can be recharged without a wire link.

Other Computers in Other Places

Much of the communication with other machines will be with those of the same model, through e-mail. We will also make use of large database machines that will spring up as resource centers. Despite the large storage capacity of *LaserCard*, there is no hope that everyone will physically be able to own all the data they will ever need. This information will sit on a database machine which we will pay for by the gigabyte whenever information is accessed. There are significant and difficult economic issues about who will pay to create new information, and it is reasonable to expect newer information to be more expensive than old. Simple calculations show the Library of Congress contains about 20 terabytes of information, which will fit on about 20,000 *LaserCards*. Thus, the actual size of a database machine is not necessarily large. The biggest task for such information centers will be to keep up with and make available new knowledge being created around the globe.



One gigabyte per *LaserCard* is a lot of storage, and 20 terabytes is even larger. Keywords and subject headings will be inadequate for the task of referencing all this information. There is a famous story about "the universal library" constructed from all possible character sequences of sufficient length, which contained all the books that could ever be written. Unfortunately, such a library is utterly useless, since the catalog has to be as large as the library itself.

To effectively search our more modest libraries, we will use automatic indexing programs to construct our catalog. These programs might map all English words and proper names into, say, 2¹⁶ different classes. A bit

vector of this size can be prepended to each document, where a bit is set if a member of the corresponding word class appears in that document. Thus we can quickly identify the set of documents relevant to our query by comparing the document vector against a vector of all possible aspects, spellings, and synonyms for our search. Such a system can "infer" by analyzing the similarities between the vectors of related documents. Similar indexing techniques can be used for music and video, so we can search for songs similar to our favorite Beatles tune.

Of course, there will exist problems for which the processing power available in an 8½" × 11" box is not enough. Large, parallel, special purpose supercomputers will be readily tapped for such applications. One fanciful solution would be for the U.S. government to pull the plug on the \$6 billion supercollider (pending the inevitable progress in high temperature superconductors) and use this money to produce a massively parallel computing "power station." With this amount of resources, a billion processor Connection Machine [5] or a thousand processor Cray could easily be constructed and maintained. Anyone could call up and use some section of this machine, paying for the time and number of processors used. For research applications, perhaps the entire machine would be devoted to a single problem, making what was once intractable almost instantaneous. Applying such a tool to genetic sequences or long term weather forecasting has the potential to truly improve the quality of life for everyone. And applying small portions of it to such amusements as interactive movies present interesting possibilities.

THE IMPLICATIONS FOR WORK

A growing number of professionals bothered by the hassle and inconvenience of commuting to the city and work are opting to work at home. This has been made possible largely by the development of personal computers, since the facilities of the office can be replicated at home. Communication with co-workers can be maintained via telephone and occasional office visits. TABLET has the possibility of accelerating this trend and pushing it in a new direction.

The insight is that with a truly portable computational and communication tool, we are not restricted to working in the office or at home. We can work anywhere. TABLET will provide access to anything we are used to having at the office, so there is no reason not to work somewhere else. On a sunny day we can take our work to a park, and not fear being out of touch for an important message. The distinction between work and vacation will blur. Perhaps the biggest drawback of work-at-home, however, is the loss of social contact with co-workers. But now we can take our work to where people are, instead of moving people to where the work is.

Video conferencing will be vital if people are to communicate effectively from afar. The CCD camera, video compression processor, and cellular link make this a

reality almost anywhere. Today's video conferencing requires a studio and a heavy investment. We can take our conference to where the work is actually being done.

Carrying an expensive computer is unnerving for many people for fear of breakage or theft. Our design is simple and robust enough to survive a healthy jolt. The threat of theft will be eliminated since each computer will have a unique identification number. We can call up the computer after it has been stolen and use the GPS receiver to let us know exactly where it is. Try and fence merchandise *this* hot! To protect personal information, it is reasonable to take handprints with the touchscreen for identification.

Perhaps even more important than physical security is data security. A great deal of personal information will be stored on these machines, and communicated by infrared and cellular telephone. To safeguard this encryption and digital signatures will be used with all data transfer. By 2000, the general public will be familiar enough with the notion of digital signatures to trust them more than physical signatures. This will be necessary because of the ability of ray traced computer graphics to simulate any desired scene or image. The time is almost here when photographs will no longer be admissible as evidence in a court of law because they will be so easily and successfully faked.

By 2000, the marriage of computers and science will be complete. Algebra, calculus, and all aspects of mathematical calculation will routinely be done by computer, just as all arithmetic has now been relegated to calculators. Scientific journal articles will have live equations built in, so they can be checked automatically by the reader.

In the past, there were two basic approaches to science: doing experiments where one measures how a system behaves, or doing theory where one works out how a system should behave. Computers make possible another approach to science: computer experimentation, which will become the dominant method for investigating many kinds of systems. One implements an algorithm which simulates a physical system and then finds out what happens by watching the program run. There are many kinds of systems for which this approach is not only convenient, but fundamentally necessary [17]. Research in physics, biology, economics and other areas is already being directed by models inspired by digital computers. Our computer will not be big enough to predict the weather, but will be able to simulate the results of any college physics experiment. There will be very few scientists in 2000 who do not spend the majority of their time in front of a computer.

The notion of *programming* will change substantially. Programs in low level languages like C will start dying out like dinosaurs. Filling their ecological niche will be scripts for high-level interpretative systems. These programs will not be created by entering a sequence of lines of code, but rather by linking together operations using a graphical representation of the program's function. At the simplest level, a program will be just "re-playing" a sequence of commands to a high level sys-

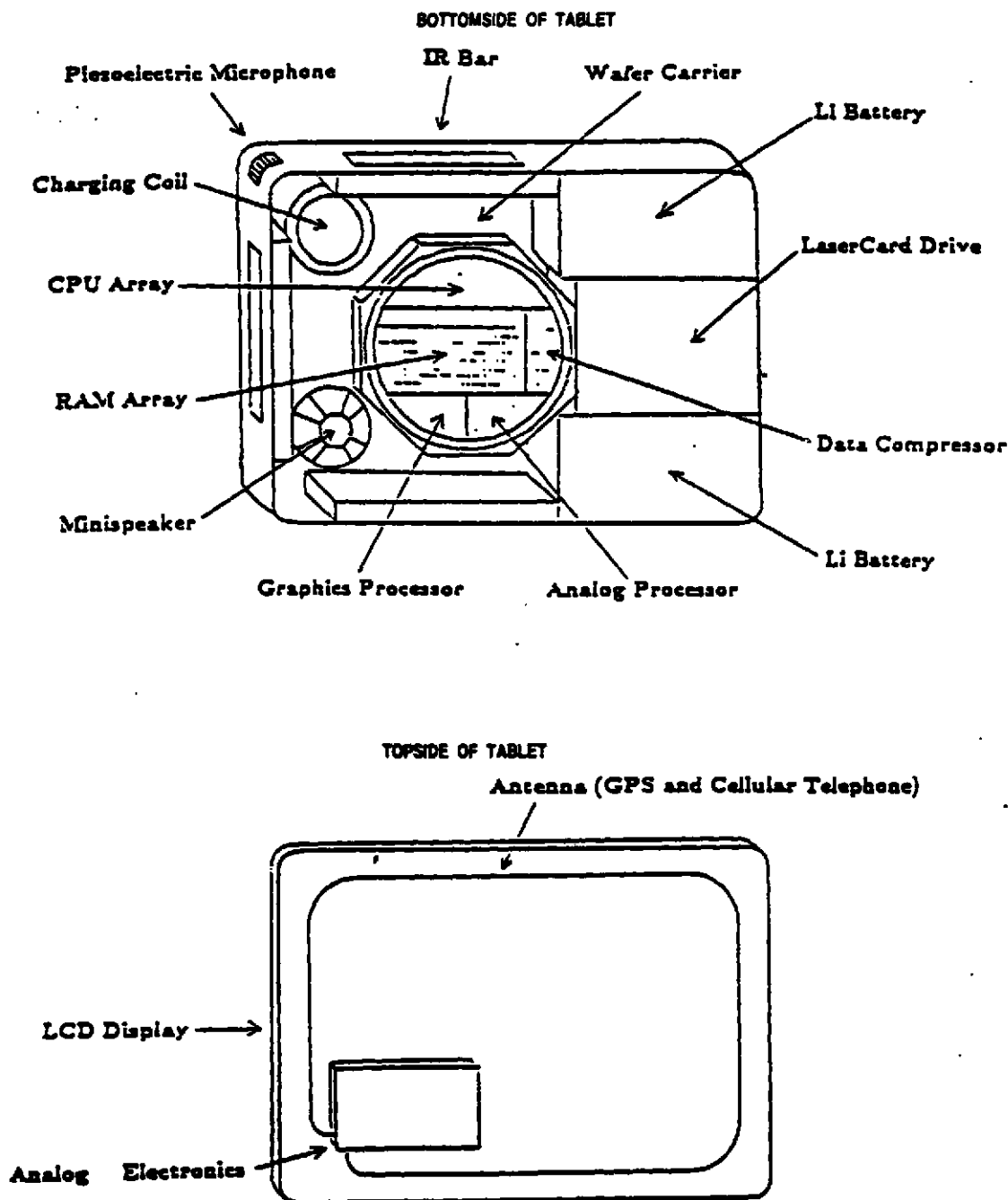


FIGURE 1. Looking Under the Hood

tem. With these systems, fewer people will call themselves programmers since a wide class of people will be able to perform programming tasks.

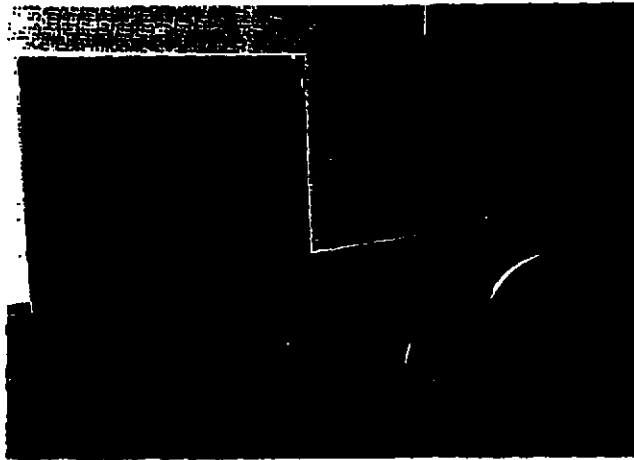
THE IMPLICATIONS FOR PLAY

Computers such as ours will provide new dimensions for recreation and education. People will have tools available for the creation of art sufficient to alter the way ideas and feelings are expressed.

Descendents of programs like *hypercard* will lead to a

redefinition of what literature is exactly. On-line books can have animation, and textbooks can have live formulae to experiment with and manipulate. Initial efforts to create hypertext novels will no doubt be artistic failures, but with time legitimate hyperliterature will be created. The time will come, perhaps not by 2000, when the Nobel Prize for Literature will be awarded for hyper instead of linear text.

Using CCD cameras and ray-traced graphics, home movies take on a new meaning. By digitally splicing



home footage with simulated scenery, the amateur will be able to produce professional looking movies the way any author can now typeset his own material. As the technical and financial obstacles to entry for such arts fall, more and more people will participate.

One interesting problem is who will appreciate all this new art? Some form of "shareware video" might arise. Other distribution channels will no doubt sprout up, but much of this art will be only for private consumption. An analogous situation already exists, as publishers have known for years that more people write poetry than read it. So it might be with shareware video. Just having a studio available does not make someone an artist.

CONCLUSIONS

Predicting the future is obviously not a well-defined task, representing a tradeoff between imagination and reality. What passes for science fiction is often based more on hopes and dreams than technological or even physical possibilities. Twelve years is not a lot of time, but it is all we have until the year 2000. This sets some hard limits on what is possible. Many futurists may choose to ignore these, but as Spanish painter Francisco Goya said, "imagination abandoned by reason produces monsters."

There is no major aspect of our machine which is not in some sense sitting in a laboratory today. We do not suppose a breakthrough in artificial intelligence, superconductivity, or any other sexy technologies, as foretelling their destiny is still the province of psychics, not scientists. We do not rely on the construction of a new, national infrastructure such as a fiber optic link to each home, since this will require at least a generation to complete. We look at what is possible and start from there. The creativity in our design involves synthesis, uniting disparate elements into a clean and satisfying whole.

Reading through old issues of *Popular Science* shows how difficult it is to predict the future. Cover stories have focused on such discoveries as polywater and such budding technologies as the flying car. In fact, one

might suspect an appearance on the cover of *Popular Science* is the kiss of death for any breakthrough.

This serves to provide us with some humility concerning our predictions. Still, our vision is both realizable and desirable. We all want this little machine, and twelve years of engineering will make it a reality. The sooner Apple gets to work on it, the better for everyone.

REFERENCES

1. Baker, A. "Silicon Compilers: Chip Design for Systems Designers." *Computer Design* (July 1986), p. 66.
2. Bruno, R. "Making Compact Disks Interactive." *IEEE Spectrum* (November 1987), Vol. 24, pp. 40-45.
3. Casey, R.G. "Text OCR by Solving a Cryptogram." In: *Eighth Int. Conf. on Pattern Recognition*, IEEE, New York, 1986, pp. 349-351.
4. Compton, T.R. "Small Batteries." In: *Primary Cells*, MacMillan Press Ltd., London, 1982.
5. Hillis, D. *The Connection Machine*, MIT Press, Cambridge MA, 1980.
6. Hudak, G. "NAVSTAR Global Positioning System Collins User Equipment: an Evolutionary Assessment." *Navigation* (1986), Vol. 33, pp. 1-19.
7. Judice, C.N., and LeGall, D. "Telematic Services and Terminals: we ready?" *IEEE Communications Magazine* (July 1987), Vol. 25, pp. 19-29.
8. Kahn, F.J., and Birecki, H. "Multiplexing Limits of Twisted Nematic Liquid Crystal Displays and Implications for the Future of High Information Content LCDs." In: *The Physics and Chemistry of Liquid Crystal Devices*, Gerald I. Sprokel, ed. Plenum Press, New York, 1980, pp. 79-93.
9. Kay, A. "A Personal Computer for Children of All Ages." Draft, Xerox Palo Alto Research Center, 1972.
10. Lundstrom, S., and Larsen, R. "Computer and Information Technology in the Year 2000—a projection." *Computer* (September 1985), Vol. 18, pp. 68-79.
11. Meiklejohn, W.H. "Magnetooptics: a Thermomagnetic Recording Technology." *Proc. IEEE* (1986), Vol. 74, pp. 1570-1581.
12. Nagy, G., Seth, S., Einsphahr, K., and Meyer, T. "Efficient Algorithms to Decode Substitution Ciphers with Application to OCR." *Eighth Int. Conf. on Pattern Recognition*, IEEE, New York, 1986, pp. 352-355.
13. Pahlavan, K. "Wireless Communications for Office Information Networks." *IEEE Communications Magazine* (June 1985), Vol. 23, pp. 19-27.
14. Tanaka, T., and Kobayashi, S. "Entry of Data and Command for LCD by Direct Touch: An Integrated LCD Panel." In: *1986 SID International Symposium Digest of Technical Papers*, 1986, pp. 318-320.
15. Tappert, C.C. "Cursive Script Recognition by Elastic Matching." *Journal of Research and Development* (November 1982), Vol. 26, pp. 763-771.
16. Welch, T. "A Technique for High-Performance Data Compressions." *Computer* (June 1984), Vol. 17, pp. 8-19.
17. Wolfram, S. "Computer Software in Science and Mathematics." *Scientific American* (September 1984), Vol. 251, pp. 188-203.
18. Ziv, J., and Lempel, A. "A Universal Algorithm for Sequential Data Compression." *IEEE Transactions on Information Theory* (May 1977), Vol. IT-23, pp. 337-343.

CR Categories and Subject Descriptors: K.8 [Personal Computing]. Additional Key Words and Phrases: Future of computing, PC, global positioning system, cellular data communications, Apple's Project 2000, I/O surface, laser card, touch-sensitive color LCD.

Authors' Present Addresses: Luke Young and Kurt Thearling, Computer Systems Group, Coordinated Science Lab., University of Illinois, 1101 W. Springfield Ave., Urbana, IL 61801; Arch Robison and Steven Skiena, Department of Computer Science, University of Illinois, 1304 W. Springfield Ave., Urbana, IL 61801; Bartlett Mel, Stephen Omohundro and Stephen Wolfram, Center for Complex Systems Research, 500 S. Sixth St., Champaign, IL 61821.

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Reference 1.0

DOS Fundamentals

From *DOS reference Manual*

Chapter 5. Using Tree-Structured Directories

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Introduction

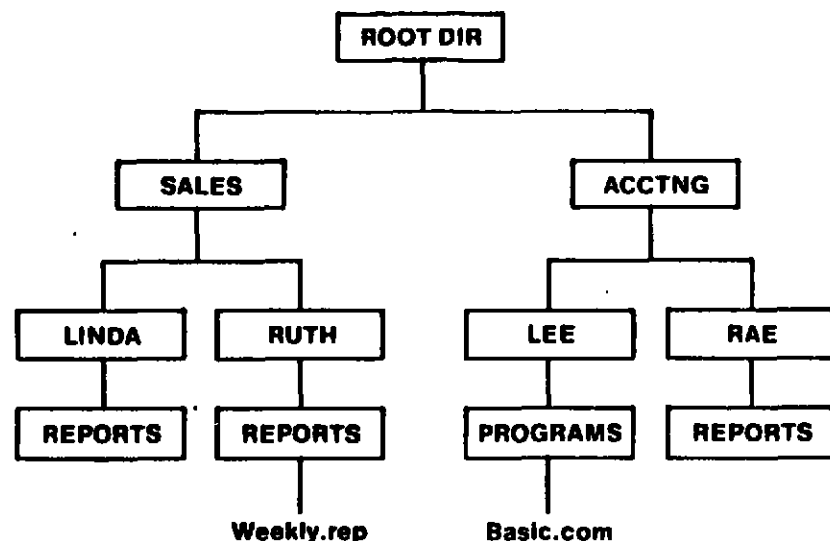
This chapter describes how to organize files into groupings called directories. It tells you how to create, access, remove and display the contents of your directories. It also tells you how to display the entire directory structure of your disk.

Why Use Directories?

A fixed disk can have many files. If you keep a large number of files in one place on your fixed disk, it can take longer for DOS to find a particular file. Keeping files in related groups in directories can reduce the time required to locate a file.

How Directories Are Organized

To give you an idea of how you might group files into directories, let's assume your company has two departments — sales and accounting — that use an IBM Personal Computer. All of the sales and accounting files are kept on the computer's fixed disk. The directory structure might look like this:



This directory structure reflects the organization of each of the two departments. Directories can be created on different levels. The highest level is the *root directory*. DOS creates a root directory on each disk when you format it. When you start DOS on your computer, you are in the root directory.

Just below the root directory shown in the previous diagram, are two *subdirectories* — one for sales and one for accounting. One level below the subdirectory named SALES, you find two more subdirectories. These two subdirectories can contain files for the salespersons, Ruth and Linda. The complete name of Ruth's subdirectory is actually \SALES\RUTH. The complete name of Linda's subdirectory is \SALES\LINDA.

Ruth and Linda can store files related to their work in their respective subdirectories. But suppose Ruth and Linda want to keep all files related to reports separate from their other files. On the next level, each has a subdirectory named REPORTS. The complete name of each subdirectory is \SALES\RUTH\REPORTS and \SALES\LINDA\REPORTS.

Note: Sales files of a general nature, not related to a particular salesperson, can be stored in SALES.

Directory Entries

A directory *entry* can be a file, a subdirectory, or a volume label. The number of entries that the root directory of a disk can contain depends on the type of disk. The root directory of a single-sided diskette can hold 64 entries, while the root directory of a double-sided diskette can hold 112 entries. The root directory of a high-capacity diskette can hold 224 entries. There can be 512 entries in the root directory of a fixed disk.

Unlike the root directory, subdirectories can contain any number of entries, limited only by the amount of available space on the disk.

Subdirectory names follow the same format as filenames. They can consist of 1 to 8 characters followed by an optional extension of a period and 1 to 3 characters. All characters valid for filenames are also valid for subdirectory names.

Accessing Your Subdirectories

You need to know how to get to your subdirectories and how to access files located in a subdirectory other than the one you are working in. This section discusses:

- The current directory
- The CHDIR command (Change Directory command)
- Specifying a path to a file
- Using the PATH command
- Using PATH in a batch file

The Current Directory

The *current directory* is the one you are currently working in or the one you *were* working in on a different drive. DOS remembers which directory was current on each of your drives, even though you may not be presently accessing any of those drives. When DOS starts, the root directory is the current directory (until you change directory using the CHDIR command).

Changing Directories with CHDIR

Use the CHDIR (CD) command to move in and out of your directories (make a different directory the current directory). For example, if you are in the root directory, and want to work with files in \SALES\LINDA\REPORTS, type:

```
C>cd \SALES\LINDA\REPORTS      (Press Enter)
```

You must “go through” SALES and LINDA to get to REPORTS. The leading backslash is really not necessary if you are currently in the root directory.

If you are in LINDA and you want to change to the REPORTS subdirectory, you type:

```
C>cd reports      (Press Enter)
```

You always get back to the root directory no matter where you are in the directory structure, by typing:

```
C>cd \      (Press Enter)
```

The backslash (\) signifies the root directory.

The longest path that you can specify with CHDIR is 64 characters.

Specifying a Path to a File

When you want DOS to locate a file, and you do not specify a particular directory, DOS searches only the current directory of your default drive.

DOS can search for a file in a directory other than the current directory of your default drive. To do so, DOS must know three things — the drive, the name of the directory, and the name of the file.

These three components can be combined to create a *path* to a file. For example, if your default drive is A,

and you want to copy a file named WEEKLY.REP from drive C in the directory \SALES\RUTH\REPORTS to drive A, type:

```
A>copy c:\sales\ruth\reports\weekly.rep (Press Enter)
```

This command copies the file WEEKLY.REP from a directory three levels below the root on drive C to the current directory on drive A. Note that the filename is the last item in the path.

Using the PATH Command

You can use the PATH command to tell DOS where to search for executable files that it does not find in the current directory. This search is valid only for files with an extension of .EXE .BAT, or .COM. Data files cannot be located using PATH.

To start a search from the root directory, the path specified in the PATH command must begin with a backslash. Otherwise, the search begins at the current directory.

Let's suppose that you have several applications that require BASIC.COM in order to run. BASIC.COM is only on drive C in the directory \ACCTNG\LEE\PROGRAMS. Your application programs are on diskette and may be run from either drive A or drive B.

You can set the PATH so that DOS looks for BASIC.COM, or any other executable file that may be needed to run your applications or manage your files. DOS searches the directories in the exact order that you specify in the PATH command. Given the diagram at the beginning of the chapter, a valid path is:

```
C>path c:\sales\linda\reports\;c:\acctng\lee\programs
```

After you start the application program, at a specific point, BASIC.COM is required in order for the program to continue. In this example, DOS searches

the current directory of the default drive and then the path that you set when you started the computer. DOS finds the required file in \ACCTNG\LEE\PROGRAMS on drive C. Your application program can continue because BASIC.COM has been invoked.

For more information, see the PATH command in Chapter 7 of this book.

Using PATH in a Batch File

You can avoid having to set the PATH each time you turn on your computer. Include the names of your most-used directories in a PATH statement in an AUTOEXEC.BAT file in the root directory of the disk from which you start DOS.

AUTOEXEC.BAT is a special type of batch file that DOS looks for when you first start your computer. If DOS finds AUTOEXEC.BAT in the root directory, it executes the statements it finds there. The previous example is a valid path that can be included in an AUTOEXEC.BAT file.

Using Directory Commands

The following commands help you create and manage your subdirectories and directory structure:

- **MKDIR (MD)**—used in making a new subdirectory.
- **RMDIR (RD)**—used in removing a subdirectory.
- **CHDIR (CD)**—used in displaying and changing the current directory.
- **TREE**—used in displaying the entire directory structure of a disk.

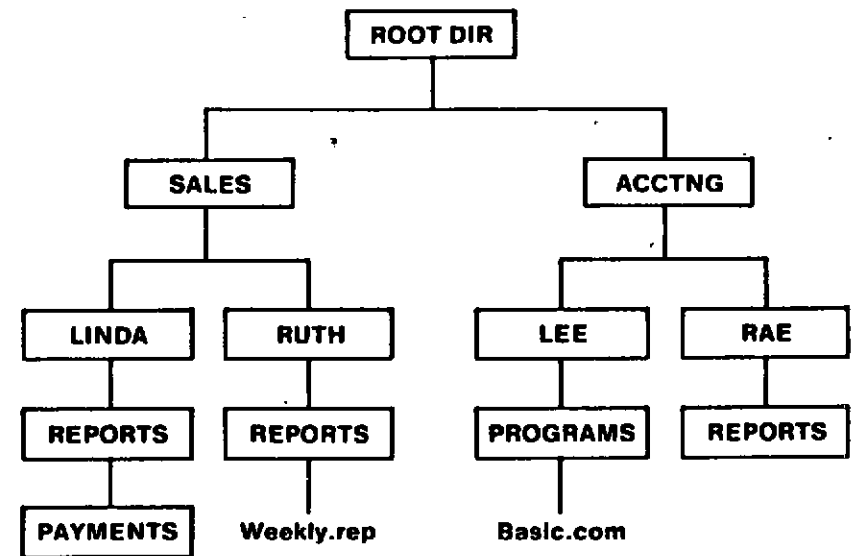
Making a Subdirectory

Use the MKDIR (MD) command to make a new subdirectory. Be sure to include the appropriate drive and path, ending with the name of the new subdirectory you want created.

Let's assume you want to add the PAYMENTS subdirectory one level below SALES\LINDA\REPORTS. Make sure you are in the root directory of the correct disk drive and type the following:

C>MD SALES\LINDA\REPORTS\PAYMENTS (Press Enter)

The resulting subdirectory structure looks like this:



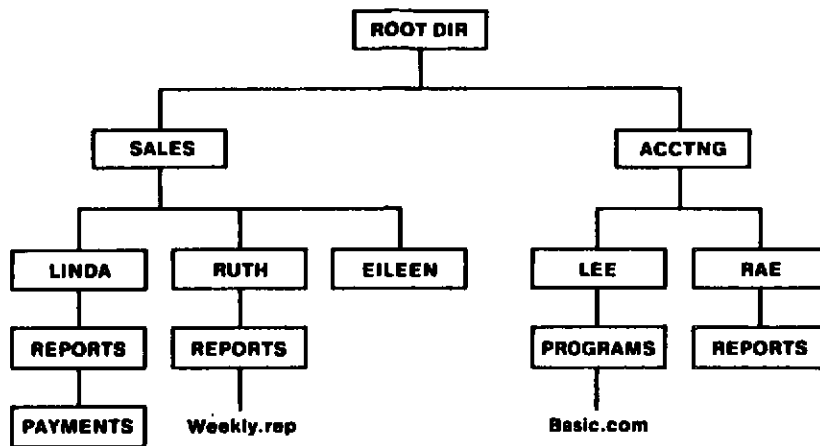
Assume you want to add a subdirectory for a third salesperson just below the SALES subdirectory. The salesperson is Eileen. If you are in the root directory, type:

`C>md \sales\eileen` (Press Enter)

If you are in the SALES directory, type:

`C>md eileen` (Press Enter)

The directory structure of your fixed disk now looks like this:



Removing a Subdirectory

Use the RMDIR (RD) command to remove a subdirectory. You cannot remove a subdirectory by using the ERASE or DEL commands. Before removing a subdirectory, keep the following in mind:

- A subdirectory can be removed only if it is empty. That is, it contains only the special entries (.) and (..). When you display the contents of a subdirectory, using the DIR command, you see those two special entries listed.
- Only one subdirectory can be removed at a time — only the last one specified in the path.
- The root directory and the current directory cannot be removed.

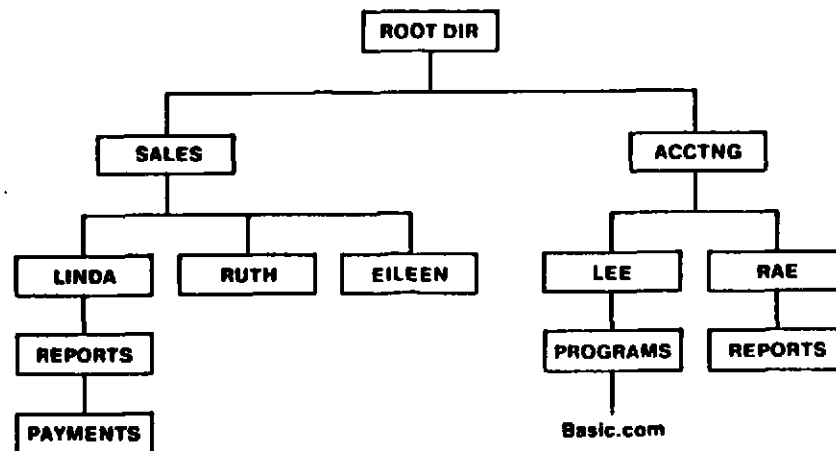
Let's assume you want to remove the REPORTS subdirectory from \SALES\RUTH\REPORTS.

- If you are in the root directory, change directory to the subdirectory you want to remove by typing `CD \SALES\RUTH\REPORTS`.
- Type `erase *.*` to remove all files in the \SALES\RUTH\REPORTS subdirectory.

Note: No files are erased from the SALES or RUTH subdirectories, only from the REPORTS subdirectory.

- Change directory to the level above the REPORTS subdirectory that you want to remove by typing `cd \SALES\RUTH`.
- Type `RD REPORTS` to remove the subdirectory.

The directory structure now looks like this:



Displaying and Changing the Current Directory

As previously mentioned, you change from one subdirectory to another using the CHDIR (CD) command. See the section entitled, "Changing Directories with CHDIR" earlier in this chapter for more information.

You can also display which subdirectory you are currently working in by typing:

cd (Press Enter)

Displaying the Directory Structure

Use the TREE command to find out the names of each subdirectory on a disk. For example, to see the directory structure for disk C, type the following:

A- TREE C:

For more information on the TREE command, see Chapter 7 of this book.

Where DOS Looks for Commands and Batch Files

When you type a command, if it is an external file, DOS must locate the command file in order to execute the command. You must specify the location (path) that describes which drive and directory the command file is in. You do this by typing the path before the command itself. You can use the PATH command to tell DOS what paths to search if it does not find the command file in the current directory or the path specified on the command line.

Note: This search is only valid for files with a .EXE, .BAT, or .COM filename extension. Data files cannot be located by using the PATH command.

CHDIR (Change Directory) Command

Purpose: Changes the DOS current directory of the specified or default drive, or displays the current directory path of a drive.

Format: CHDIR [*d:*][*path*]

or

CD [*d:*][*path*]

Type: Internal External

Remarks: Specify the parameters:

[*d:*] to specify the drive specifier of the disk whose current directory you want to change or display.

[*path*] to specify the current directory path. The path cannot be more than 64 characters starting from the root directory.

DOS looks in the current directory to find files whose names are entered without specifying a path. If you do not specify a drive, the default drive is assumed.

Type CHDIR or CD with no parameters to display the current directory path of the default drive.

Example: The following example changes the current directory of the default drive to its root directory:

A>chdir \

CHDIR (Change Directory) Command

The following example displays the current directory path of drive B.

```
A>cd b:
```

The following example changes the current directory of drive B to the path \LEVEL1\LEVEL2.

```
A>cd b:\level1\level2
```

The following example changes the directory of drive B to the current directory path plus LEVEL3:

```
A>cd b:level3
```

Thus, if the second example is used, the resultant path would be:

```
\LEVEL1\LEVEL2\LEVEL3
```

The search for the LEVEL3 directory begins in the directory that was current when the command was issued, because no leading backslash (\) was used.

The following example changes the current directory of drive B to \LEVEL1.

```
A>cd b:\level1
```

The leading backslash (\) tells DOS to start at the root directory. DOS remembers the current directory for each drive on the system, and any reference to a drive will access the current directory.

CHDIR (Change Directory) Command

Important: The true directory can be hidden by ASSIGN, SUBST, and JOIN. The following example describes a method of using C: while actually on A:.

```
A>join c: a:\cdrive  
A> cd .cdrive  
A>dir
```

COPY Command

COPY also copies files to the same disk. In this case, you *must* give the copies different names unless different directories are specified; otherwise, the copy is not permitted. Concatenation (combining of files) can be performed during the copying process.

You can also use **COPY** to transfer data between any of the system devices. An example of how to copy information that you type at the keyboard to a file is provided at the end of the description of **COPY** Option 2.

Specify **/V** to cause DOS to verify that the sectors written on the target diskette are recorded properly. Although errors in recording data are very rare, this option has been provided for those of you who wish to verify that critical data has been correctly recorded. This option causes the **COPY** command to run more slowly, due to the additional overhead of verification.

The **/V** parameter provides the same check as does the **VERIFY ON** command. **/V** is redundant if the **VERIFY ON** command has been executed previously. The difference is that **/V** is effective only during the duration of the **COPY** command. The **VERIFY ON** command is in effect until **VERIFY OFF** is entered.

The parameters **/A** and **/B** indicate the amount of data to be processed by the **COPY** command. Each applies to the filespec preceding it and to all remaining filespecs on the command line until another **/A** or **/B** is encountered. These parameters have the following meanings:

COPY Command

When used with a *source* filespec:

/A Causes the file to be treated as an ASCII (text) file. The file's data is copied up to, but not including, the first end-of-file character (Ctrl-Z, which is 1AH) found in the file the remainder of the file is not copied.

/B Causes the entire file (based on the directory file size) to be copied.

When used with a *target* filespec:

/A Causes a Ctrl-Z character to be added as the last character of the file.

/B Causes no end-of-file character (Ctrl-Z) to be added.

The default values are /A when concatenation is being performed (see Option 3 below), and /B when concatenation is not being performed (Options 1 and 2).

Notes:

1. When copying to or from a reserved device name, the copy is performed in ASCII (/A) mode. The first Ctrl-Z character encountered will end the copy unless /B was specified.
2. If you make a copy of a file that is marked read-only, the copy will not be marked read-only.
3. You cannot use COPY to transfer a file using the COM or AUX serial ports.

COPY Command

You can use the global characters ? and * in the filename and in the extension parameters of both the source and target files. If you type a ? or * in the source *filespec*, the names of the files will be displayed as the files are being copied. For more information about global characters, refer to "Global Filename Characters" in Chapter 2.

The COPY command has three format options:

Option 1 - Copy with Same Name

Use this option to copy a file with the target file having the *same* filename and extension as the source file. For example:

COPY [d:][path]filename[.ext]

or

COPY [d:][path]filename[.ext] d:[path]

In the first example, we want to copy a file to the current directory of the default drive. In the second example, we specify the target drive and/or directory. In both examples, because we did not specify the second filename, the copied file will have the same filename as the source file. Because we did not specify a name for the second file, the source drive and the target drive must be different unless different directories were specified or implied; otherwise, the copy is not permitted.

For example, assume the default drive is A. The command:

A-copy b:myprog

COPY

Command

copies the file MYPROG from drive B to the current directory on the default drive A, with no change in the filename. The command:

```
A>copy *.* b:
```

copies all the files in the current directory from the default drive A to drive B, with no change in the filenames or in the extensions. The filenames are displayed as the files are copied. This method is very useful if the files on drive A are fragmented. The command:

```
A>copy b:\myprog b:\level1
```

copies the file MYPROG from the root directory of drive B to the directory path:

```
\level1
```

on the same drive. The copy has the same filename as the original file. Note that the above example assumes that directory \LEVEL1 exists on drive B. If it did not, then the file MYPROG would have been copied into a file named LEVEL1 in the root directory of drive B. In other words, if the second parameter specifies a directory that exists, the file (or files) will be placed in that directory, keeping the same filename. If the second parameter does not specify a directory that exists, DOS will treat it as a filename.

COPY

Command

Option 2 - Copy with Different Name

Use this option when you want the copied file to have a different name from the file being copied. For example:

```
COPY [d:][path]filename[.ext]  
[path]filename[.ext]
```

or

```
COPY [d:][path]filename[.ext]  
d:[path]filename[.ext]
```

In the first example, we copied a file (first file specified), and renamed the copy (second file specified). We did not specify a drive, so the default drive was used. In the second example, we copied a file and renamed the copy also. In this example, we did specify the target drive. Because we changed the name of the file, the source drive and the target drive do not have to be different. The current directory can be the same or different.

For example:

```
A>copy myprog.abc b:*.xxx
```

Copies the file MYPROG.ABC from the diskette in the default drive (drive A in this example) to drive B, naming the copy MYPROG.XXX. The current directory of each drive was used.

You can also use reserved device names for the copy operation. For example:

COPY Command

```
copy con fileA
copy con aux
copy con lpt1
copy filea con
copy fileb aux
copy filec lpt2
copy aux lpt1
copy aux con
```

Also, NUL can be used in any variation.

Refer to "Reserved Device Names" in Chapter 2 for information about system devices.

This example shows how to use COPY to put what you type from the keyboard into a file:

```
A>copy con filea
```

Type a line and press Enter.
Type your next line and press Enter.

.

Type your last line and press Enter.
Now, press F6 and then press Enter.

When you press F6, and then press Enter, the COPY operation ends and saves the information you entered. In this example, the information is saved in a file named FILEA.

Note: This example assumes that you have not altered the meaning of F6 through the "Extended Screen and Keyboard Control" functions described in Chapter 3 of the *DOS Technical Reference*. If you have, then substitute the key that you have assigned Ctrl-Z for F6 in this example.

COPY Command

Option 3 - Copy and Combine Files

Use this option when you want to combine files while copying. That is, you can combine two or more files into one file by adding the additional files to the end of the first. The date and time recorded in the result file directory are the current date and time. The message indicating the number of files copied refers to the number of result files created.

To combine files, list any number of source files, separated by plus (+) signs in the COPY command. Use the following format:

```
COPY [/A[/B][d:[path]filename].ext[/A[/B]
```

```
[+{d:[path]filename].ext[/A[/B]...]
```

```
[d:[path]filename].ext[/A[/B[/V]
```

For example:

```
A>copy a.xyz+b.abc+b:c.txt bigfile.txt
```

This command creates a new file called BIGFILE.TXT on the default drive. The combination of A.XYZ, B.ABC, and B:C.TXT is put into BIGFILE.TXT.

If you do not specify a result *filename*, the additional files are added to the end of the first file, leaving the result in the first file. For example,

```
A>copy a.asm+h.asm
```

COPY Command

In this case, COPY appends B.ASM to the end of A.ASM and leaves the result in A.ASM.

Note: Combining files is normally performed in text (or ASCII) mode. That is, the first Ctrl-Z (hex 1A) character in the file is interpreted as an end-of-file mark. To combine binary files, use the /B parameter to force COPY to use the physical end-of-file (the file length shown in the DIR command).

You can also combine ASCII and binary files by using the following parameters:

- ASCII - /A
- Binary - /B

For example,

```
A>copy a.xyz+b.com b+h:c.txt a bigfile.txt
```

A /A or /B takes effect on the file it is placed after, and it applies to all subsequent files on the command line until another /A or /B is found. A /A or /B on the result file causes a Ctrl-Z to be added (/A), or not to be added (/B), as the last character in the result file.

You can use the global characters ? and * in the filenames of both the files to be combined and the result file. For example:

```
A>copy *.lst combin.prn
```

In this example, all files matching *.LST are combined into one file called COMBIN.PRN:

```
A>copy *.lst+*.ref combin.prn
```

COPY Command

This example combines all files matching *.LST and then all files matching *.REF into one file called COMBIN.PRN:

```
A>copy *.lst+*.ref *.prn
```

In this example, each file matching *.LST is combined with the corresponding .REF file, with the result having the same name but with extension .PRN. Thus, a file FILE1.LST would be combined with FILE1.REF to form FILE1.PRN; XYZ.LST would be combined with XYZ.REF to form XYZ.PRN; etc. Note that in this case (when multiple files are to be created), only one file from each of the source filespecs is used to create a given target file.

For more information about global characters, refer to "Global Filename Characters" in Chapter 2.

It is easy to enter a COPY command to combine files where one of the source files is the same as the target, yet this often cannot be detected. For example:

```
A>copy *.lst all.lst
```

This would produce an error if ALL.LST already existed. The error would not be detected, however, until it was time for ALL.LST to be appended; by this time, ALL.LST could already have been altered.

COPY handles this situation as follows: As each input file is found, its name is compared with the target filename. If the names are the same, that one input file is skipped, and the following message is displayed on the screen:

Content of destination lost before copy

COPY Command

Further copying proceeds normally. This allows *summing* files, with a command like:

```
A>copy all.lst + *.lst
```

This command appends all .LST files, except ALL.LST itself, to ALL.LST. In this case, the error message is suppressed, because this is a true *physical append* to ALL.LST.

The following are special cases. Remember to use the /B parameter whenever you use the plus (+) sign with non-ASCII files:

```
A>copy b:xyz.asm+
```

This command copies the file XYZ.ASM to the default drive and gives it a new date and time. To simply change the date and time, leaving the file in place, you can use the following command:

```
A>copy b:xyz.asm+,, b:
```

In these special cases, if global filename characters are used in the filename or extension, then all of the matching files will be appended together into the first filename that matches. Thus, the command:

```
A>copy b:*.*,, b:
```

will not update the dates and times of all files on drive B, but will append all of drive B's files together into a single file that will replace the first file found on drive B.

COPY Command

Note: When combining files, COPY considers the copying process to be successful if at least one, but not necessarily all, of the named source files is found. If none of the source files can be found, you receive the message

0 file(s) copied

DEL (Delete) Command

Purpose: Deletes the specified file.

Format: DEL [*d:*][*path*]*filename*[*.ext*]

Type: Internal External

Remarks: Specify the parameters:

[*d:*] to specify the drive that contains the file you want to delete.

[*path*] to specify the directory path that contains the file you want to delete.

filename[*.ext*] to specify the name of the file you want to delete.

Notes:

1. If the drive specifier is not specified, the default drive is assumed.
2. If the path is not specified the current directory is assumed.
3. If the filename is not specified, *.* is assumed and all files are deleted.
4. You can use the global filename characters ? and * in the filename and extension. However, use global filename characters with caution because multiple files can be deleted with a single command.

DEL (Delete) Command

5. If you use the filespec *.* to delete all the files on a disk, the following message is displayed to verify that you actually want to delete all files:

Are you sure (Y/N)?

Type y (yes) and press Enter if you *do* want to delete all the files on the disk.

Type n (no) and press Enter if you do not want to erase all files on the disk.
6. You cannot delete files that are marked as read-only.
7. You cannot use DEL to delete a subdirectory. To delete a subdirectory, use the RMDIR (remove directory) command.
8. Extra care should be exercised when using DEL after using ASSIGN, JOIN, or SUBST.

Example: The following example deletes the file name FILE.BAT from the diskette in drive A.

```
A>del a:file.bat
```

The following example deletes all files from the directory \LEVEL1 on drive C.

```
A>del c:\level1
```

DIR (Directory) Command

Purpose: Lists either all the directory entries, or only those for specified files.

Note: Directory entries for hidden system files such as IBMBIO.COM and IBMDOS.COM are not listed, even if present.

Format: DIR [*d*:[*path*][*filename*].*ext*][*/P*][*/W*]

Type: Internal External

Remarks: Specify the parameters:

[*d*:[*path*][*filename*].*ext*]] to specify the file whose directory you want to list.

/P to pause the display when the screen is full. The following prompt is displayed:

Strike a key when ready . . .

To continue press any key.

/W to display the information in a wide display format. Only the filenames and directory names are shown. This parameter is only recommended for 80-column displays.

Notes:

1. The information provided in the directory listing includes the volume identification and the amount of free space left on the disk. The freespace amount is rounded up to the nearest

DIR (Directory) Command

DIR (Directory) Command

Volume in drive A is MYDISK
Directory of A:\LEVEL2

```

.          <DIR>      9-09-84   1:30p
..         <DIR>      9-09-84   2:45p
MYPROG    COM      2463    7-30-84   8:55a
3 File(s) 141312 bytes free

```

Note that all files in directory LEVEL2 have been listed, including the two special entries found in all subdirectories. The entry marked with a single period denotes the directory being listed (LEVEL2), and the double period denotes this directory's parent directory (in this case, the root directory). Thus, if your *current* directory is LEVEL2 and you wish to see the files in its parent directory, you can enter:

A>dir ..

Option 2 - List Selected Files

The following example lists the directory entry of the file named FILE3.A in the current directory of the default drive.

A>dir file3.a

the screen may look like this:

Volume in drive A is MYDISK
Directory of A:\

```

FILE3     A      1613    5-27-84  12:14p
1 File(s) 141312 bytes free

```

If you type:

A>dir *.a

the screen may look like this:

Volume in drive A is MYDISK
Directory of A:\

```

FILE1     A     10368    7-20-84  12:13p
FILE3     A      1613    5-27-84  12:14p
2 File(s) 141312 bytes free

```

If you type:

A>dir file1

the screen may look like this (omission of .ext defaults to *):

Volume in drive A is MYDISK
Directory of A:\

```

FILE1     A     10368    7-20-84  12:13p
FILE1     A      2288    9-02-84  12:25p
2 File(s) 141312 bytes free

```

To display only the entry for a file that has no extension, enter the filename followed by a period. In this case, the .ext does *not* default to *. For example,

A>dir file1.

DIR (Directory) Command

1024K bytes. The display line for each file includes its size in decimal bytes and the date and time the file was last written to.

Note: If you set the COUNTRY configuration command to a country other than U.S., the date and time format displayed may be different. The examples in this section show the date displayed for the U.S. date and time format.

2. Entries that name other directories are clearly identified with <DIR> in the file size field.
3. You can use the global characters ? and * in the filename and extension parameters. For more information about the global characters, refer to "Global Filename Characters" in Chapter 2.
4. If you do not specify a filename extension, the default is *.
5. To display the directory entry for a file that does not have an extension, type the filename followed by a period. In this case, the .ext does not default to *.
6. The DIR command has two format options (the /P and /W parameters may be used with either option):
 - List All Files
 - or
 - List Selected Files

DIR (Directory) Command

Example:

Option 1 - List All Files

The following example lists all the directory entries on the default drive.

A>dir

The directory may look like this:

```
Volume in drive A is MYDISK
Directory of A:\

FILE1      A           10368      7-20-83   12:13p
FILE3      A           1613       5-27-83   12:14p
9X          31              8-17-82   10:59a
LEVEL2     <DIR>          9-09-82   12:10p
FILE1      2288          9-02-82   12:25p
           5 File(s) 141312 bytes free
```

The following example lists all the directory entries for current directory of drive C.

A>dir c:

The following example lists all the directory entries for the directory path \LEVEL2:

A>dir \level2

The screen will look like this:

RENAME (or REN) Command

Purpose: Changes the name of the file specified in the first parameter to the name and extension given in the second parameter.

Format: REN[AME] [*d:*][*path*]*filename[.ext]* *filename[.ext]*

Type: Internal External

Remarks: You can use the abbreviated form REN for the RENAME command. You can also use the global characters ? and * in the parameters. For more information about global characters, refer to "Global Filename Characters" in Chapter 2. A path can be specified only with the first filename; the file will remain in the same directory after its name has been changed.

Example: The following example renames the file ABODE on drive B to HOME.

```
A>rename b:abode home
```

The following example renames the file ABODE on drive B to ABODE.XY.

```
A>ren b:abode *.xy
```

The following example renames the file MYPROG.COM in the directory \LEVEL1 on drive B to YOURPROG.COM.

```
A>ren b:\level1\myprog.com yourprog.com
```


ERASE Command

ERASE Command

Purpose: Erases the specified file.

Format: ERASE [*d:*][*path*]*filename*[.ext]

Type: Internal External

Remarks: Specify the parameters:

[*d:*] to specify the drive that contains the file you want to erase.

[*path*] to specify the directory path that contains the file you want to erase.

filename[.ext] to specify the name of the file you want to erase.

Notes:

1. If the drive specifier is not specified, the default drive is assumed.
2. If the path is not specified the current directory is assumed.
3. If the filename is not specified, *.* is assumed and all files are erased.
4. You can use the global filename characters ? and * in the filename and extension. However, use global filename characters with caution because multiple files can be erased with a single command.

5. The operating system files IBMBIO.COM and IBMDOS.COM cannot be erased.
6. If you use the filespec *.* to erase all of the files on a disk, the following message is displayed to verify that you actually want to erase all files:

Are you sure (Y/N)?

Type y (yes) and press Enter if you *do* want to erase all the files on the disk.

Type n (no) and press Enter if you do not want to erase all files on the disk.

7. You cannot erase files that are marked as read-only.
8. You cannot use ERASE to erase a subdirectory. To delete a subdirectory you need to use the RMDIR (remove directory) command.
9. Extra care should be exercised when using ERASE after using ASSIGN, JOIN, or SUBST.

Example: The following example erases the file name FILE.BAT from the diskette in drive A.

```
A>erase a:file.bat
```

The following example erases all files from the directory \LEVEL1 on drive C.

```
A>erase c:\level1
```

RENAME (or REN) Command

Purpose: Changes the name of the file specified in the first parameter to the name and extension given in the second parameter.

Format: RENAME [*d:*][*path*]*filename*[*.ext*] *filename*[*.ext*]

Type: Internal External

Remarks: You can use the abbreviated form REN for the RENAME command. You can also use the global characters ? and * in the parameters. For more information about global characters, refer to "Global Filename Characters" in Chapter 2. A path can be specified only with the first filename; the file will remain in the same directory after its name has been changed.

Example: The following example renames the file ABODE on drive B to HOME.

```
A>rename b:abode home
```

The following example renames the file ABODE on drive B to ABODE.XY.

```
A>ren b:abode *.xy
```

The following example renames the file MYPROG.COM in the directory \LEVEL1 on drive B to YOURPROG.COM.

```
A>ren b:\level1\myprog.com yourprog.com
```

Reference 2.0

Microsoft Word

Getting Started on Word

From Chapter 1

Microsoft Word Made Easy
1987

Getting Started

This chapter explains the few steps you need to follow before you can begin to use Word and shows you how to start up the program. After following the installation instructions, you can immediately start to edit and format documents; in fact, you will start using Word in Chapter 1 to enter a business letter that will be utilized throughout the next six chapters and in many other sections of the book as well.

If you have no word processing experience, the following section will give you a quick overview of many of the terms you will find in this book. If you are familiar with another word processor, you can probably skim the section very quickly.

WORD PROCESSING TERMS

Word processing programs give you two major capabilities: editing and formatting. *Editing* is the ability to enter text into the program, make corrections, save the text on disk, and later change the text. *Formatting* is the ability to specify how the text will look when you print it out. For example, formatting allows you to add special features to the printout, such as page numbers on each page, and to specify the width of the left and right margins.

In order to make a word processing program work, you give it *commands*, instructions that tell the program what you want to do. In Word, you can give commands by using the mouse or by pressing the keys on the left and right sides of the keyboard (the *function keys* and the *cursor control keys* respectively).

When you write a document, you *insert* text into a file. This is done simply by typing the text as you would on a typewriter. Once this has been done, you can use editing commands to

correct mistakes or to rearrange the text. While you are editing, you can move around in the text so you can edit different parts. When you want to see text that is not on the screen, the word processing program will *scroll*, or move, the screen to the desired location. When you are done with a file, you can *save* it on disk; when you want to use the file later, you tell the word processing program to *load* it from disk.

If you have entered text that you no longer want in the file, you can *delete* it. Word allows you to delete groups of words or lines easily; for instance, if you want to delete a paragraph, you *select* the paragraph (with a selection command) and then delete it all at once. If, instead, you want to move the paragraph to some other location in the document, you can *cut and paste* the text as if you were using scissors and tape, inserting the paragraph in a new location.

When you write longer documents, you may want to find a specific part of the text so you can edit it. The easiest way to do this is to *search* for a particular word that is in the area you want to edit. Word, like most word processing programs, can also search your entire document and automatically change one set of words to another; this is called *global search and replace*. For instance, if you use one person's name throughout a file and want to change it to another name, you only have to give one search-and-replace command. When you are editing in Word, you normally edit just one file. However, you can edit more than one file at a time by opening a *window*; this is like splitting your screen into two smaller screens.

A word processing program with many formatting features can give you finished copy that looks professionally produced. When you use a typewriter, you often do a great deal of formatting, such as *indenting* the first lines of paragraphs (usually the first five spaces from the left margin) and putting the page number on each page. Word processing programs can do many formatting tasks for you automatically. For instance, if you want to insert a standard line of text at the top or bottom of each page

(called a *header* or *footer*), you can tell the program to do that for you.

Like some other word processors, Word lets you use many different styles of characters (or *fonts*) in your text. For example, you can print in *italics*, the font used for introducing terms in this book. Other fonts that you can use in Word are boldface and SMALL CAPS. In fact, Word lets you use more fonts than most other word processors.

The way you format paragraphs can make a big difference in the appearance of the text. Word allows you to choose *ragged-right* or *justified* margins. Ragged-right text does not line up exactly; justified text lines up at the right margin, like the text in many books and magazines. In addition, some lines, like titles and headings, can be *centered* between the margins.

When you reach the bottom of a page, you may not want the remainder of a paragraph to appear on the next page; you might prefer to leave extra white space at the bottom and put the full paragraph on the next page. Word allows you to *keep* a paragraph together to make the text more readable, although the pages may have uneven lengths. For aesthetics, it is usually sufficient to prevent *widows* and *orphans*, and Word automatically does this for you. When the last line of a paragraph is typed at the top of a new page, it is called a widow; an orphan is the first line of a paragraph typed at the bottom of a page with the rest of the paragraph typed on the next page.

PREPARING FOR WORD

The Word program comes on a double-sided disk containing the programs and special files needed for running Word; this is called the *Program Disk*. A second disk, the *Utilities Disk*, contains other programs and files that are used with Word. Several other disks contain files that you will find useful. The *Spell Disk* contains the spelling check program in Word. A *Printer Disk* contains files needed to run various brands of

printers (some of these files also appear on the Utilities Disk). Word also comes with two *Learning Word* disks, which contain an interactive teaching program. (Note that some versions of Word come with a different number of disks.)

You should make a copy of each disk using the PC-DOS COPY or DISKCOPY command. Use the copies instead of the originals when you use Word. Keep the originals in a safe place, away from the computer. You may even want to store them outside of the office. In case the copies are damaged or destroyed, you can make new copies from the originals. If you are using an older version of Word, you will not be able to copy the Program Disk or the Backup Disk without the aid of a program that defeats copy-protection.

You should have a few formatted diskettes for storing the text that you enter. If you have a hard disk, you do not need these diskettes, since you can keep everything on the hard disk. Note, however, that although Word works with many brands of hard disks, it does not work with all; check with the hard-disk manufacturer.

If you have a mouse, you should install the mouse in your computer and have the mouse initialization program (sometimes called the *mouse driver*) loaded into memory before you run Word. The procedure for this is covered in Appendix E.

STARTING THE WORD PROGRAM

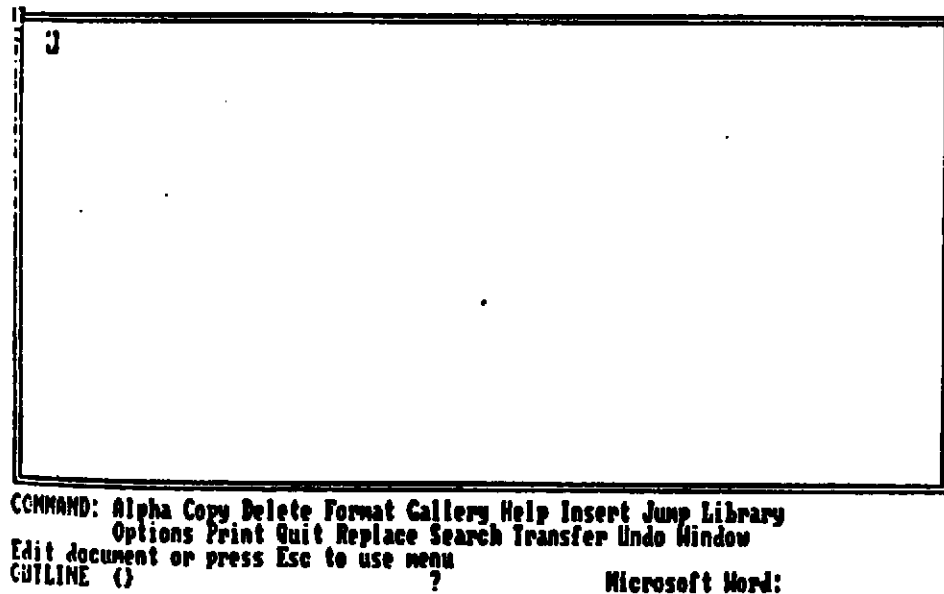
The method that you use to run Word depends on the type of disk you are using. For example, to run Word from a floppy disk system, put the Program Disk in the A: drive and give the WORD command at the following PC-DOS prompt:

A>WORD

Throughout this book, the part of the instruction in boldface is what you type in; the part in italics is what you see on the screen. For example, if you type the command WORD and then press the

Appendix E covers all of the information you need in order to start Word regardless of the type of disks you use. Since every IBM PC has at least one floppy disk drive, the method in the previous example can always be used. There are, however, different ways of starting Word if you have a special monitor or graphics card on your PC; Chapter 13 covers these.

The Word program loads in the same fashion with floppy, hard, or RAM disks. First you see the Microsoft animated logo and then Word performs some initial setup operations. When all of the initial files are read, you should see the following:



If you are using a mouse, you should see an arrow (called the *mouse pointer*) pointing up and to the left, near the middle of the screen:



You are now ready to start entering Word commands and text.

If you wish, you can start Word with the name of the file that you want to edit. For example, if you want to edit the file called **SAMPLE1**, you can give PC-DOS the command

```
A>WORD SAMPLE1
```

Word also remembers the name of the last file that you edited. If you want to edit that file again, instead of including its name on the command line, you can use the **/L** option:

```
A>WORD /L
```

GIVING WORD COMMANDS

As soon as Word is loaded, it is ready for you to start entering text. In the upper-left corner, the bright rectangle with the diamond in it is where the first letters you type will appear. You can type just as you would on a typewriter. To start experimenting, type the following words: **This is just like a typewriter**. If you make a mistake as you type, you can use the **BACKSPACE** key to erase the letter you just typed.

Now press the **F7** key a few times and then the **F8** key. Notice that the rectangle moves to the left and right, leaving the diamond at the end of the line. The rectangle is the *selection indicator*, which is described in detail later in this chapter. The diamond is a marker that shows you the end of the text and is sometimes called the *end-of-file marker*. Figure GS-1 shows the different areas of the screen.

So far you have only entered text, not edited it. To edit the text, you have to give Word commands. There are two ways to give commands: with the mouse and with the keyboard. You should read both of the following sections regardless of whether or not you have a mouse. Most concepts in this book are first explained in the sections for mouse users, since it is easier to show illustrations with the mouse. However, even if you have a mouse you should read the sections for keyboard users, since you will probably find that you will give Word commands with both the mouse and the keyboard.

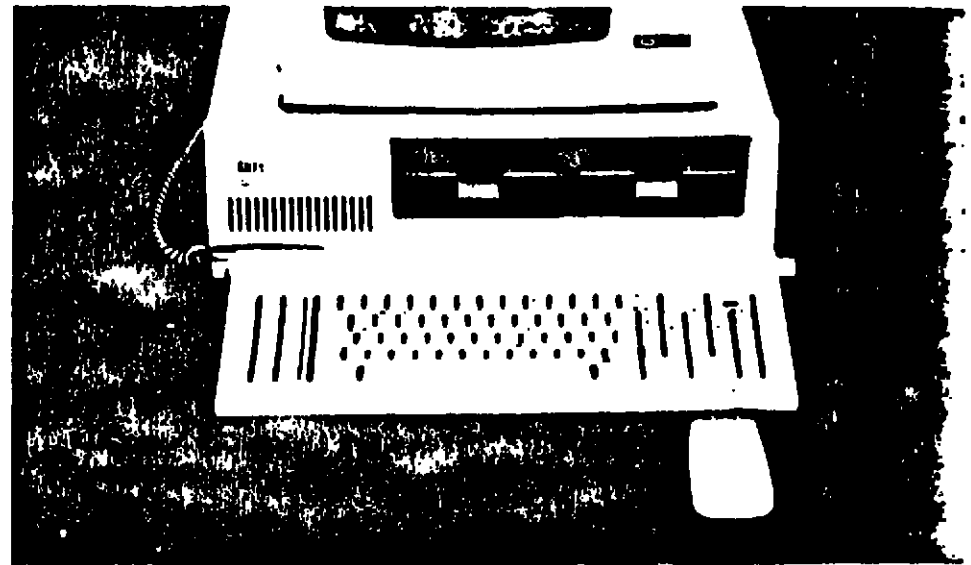
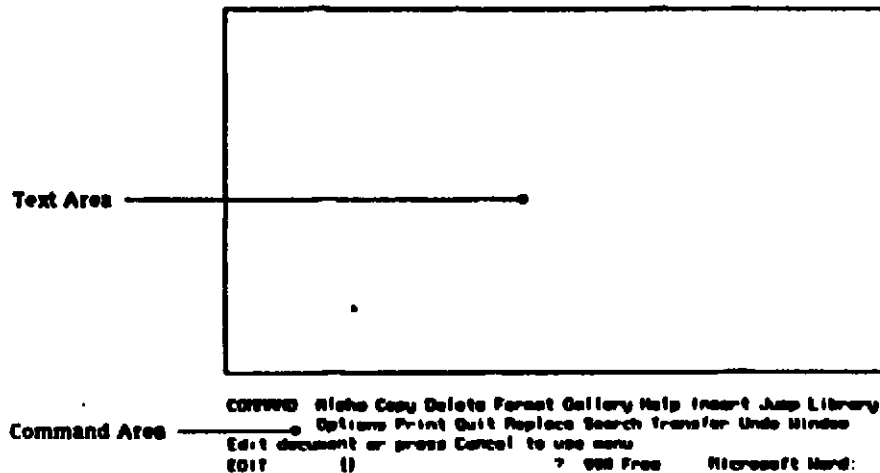


Figure GS-1 The Word screen

Figure GS-2 The Microsoft mouse

Giving Commands With the Mouse

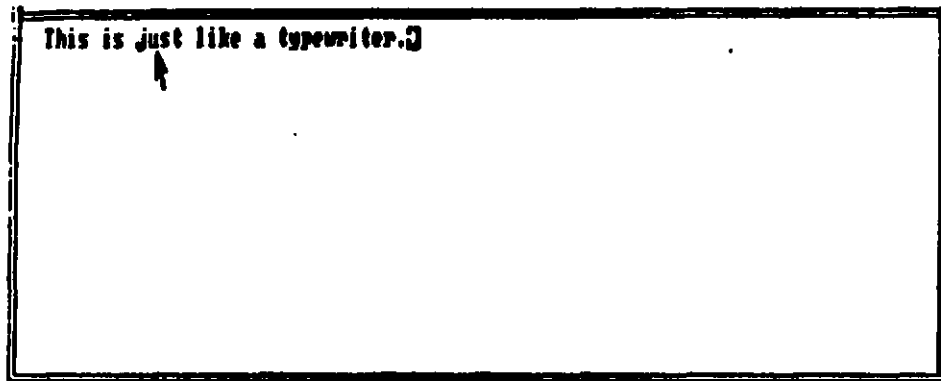
The mouse is a simple tool used for pointing at parts of the screen. The Microsoft mouse is shown in Figure GS-2.

When you move the mouse on your desk, the pointer on the screen moves in the same direction. When you press one or both of the buttons on the mouse, the mouse sends a signal to Word. The pointer on the screen can take many shapes, depending on where it is on the screen. When it is in the text area (the large area where your typed-in text will appear), it is the arrow pointing up and to the left.

Moving the mouse around on your desk moves the pointer; however, this never executes a command. To tell Word that you want to do something with a piece of information, you must point the mouse at the information and press one of the two buttons on the mouse (sometimes you will press both together).

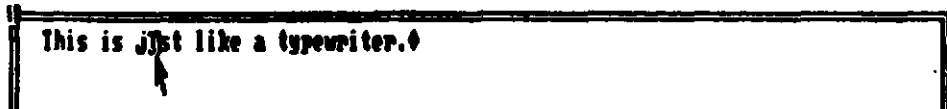
mouse; a common mistake is to press the buttons so hard that you move the mouse, with the result that the pointer is no longer where you want it on the screen. When you point at information on the screen, it is the tip of the arrow, not the whole arrow itself, that Word uses to determine what you are pointing at. If you slowly move the tip to one of the borders of the screen, you will see the shape change.

As you use the mouse, you will find that your coordination will quickly get better. As practice, first move the mouse on your desktop so that the pointer is directly on top of the letter "u" in the word "just" that you typed.



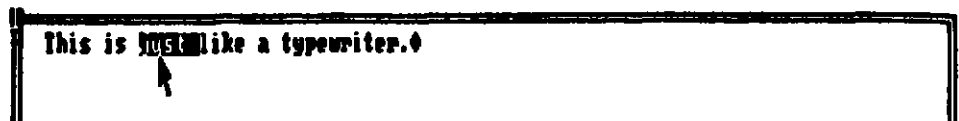
COMMAND: Alpha Copy Delete Format Gallery Help Insert Jump Library
Options Print Quit Replace Search Transfer Undo Window
Edit document or press Esc to use menu
Page 1 () Microsoft Word:

If you see a square instead of an arrow, you are pointing above the letters. Now press the left button on the mouse (the mouse's buttons should always face your keyboard). The selection indicator (shown by the highlight) now jumps to the letter "u".

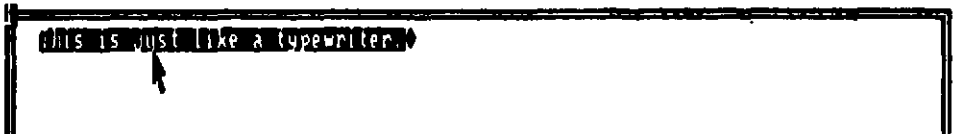


You have now given a selection command; that is, you have "selected" a portion of text. Whenever you give Word commands that have an effect on text in your file, the effect is only on the selected text. You can have anywhere from one character to the whole document selected at any time. The text that is highlighted is the text that is currently selected (in this case, the "u").

You have just seen how to select a single character with the mouse. Now, without moving the mouse, press the right button.



The selection indicator stretches to show that you have selected the whole word. Now press both buttons at once, and the whole sentence is highlighted, indicating that it has been selected.



Notice that pressing the left and right buttons causes different effects; pressing either button or both together sends a different signal depending on what you are pointing at.

You cannot move the mouse pointer completely off the screen. A bit of the pointer will always show on the screen, even if it is near the edge of the screen. You can move the pointer to the middle of the screen again simply by moving the mouse around your desktop.

As you move the mouse into other parts of the screen, its shape changes. The different shapes are symbols of the mouse's function in those areas. These symbols are sometimes called *icons*. Feel free to move the mouse pointer anywhere on the screen to see the icons; they are described in detail throughout this book in the sections that pertain to the commands that you can perform and are summarized in Appendix C.

Remember that Word never executes a mouse command until you press one or both of the buttons. In different parts of the screen, the buttons have different meanings (also summarized in Appendix C).

Once you have selected some text, you can move the pointer and the text will remain selected. Word will not change anything until you press a button on the mouse. You change the selection

by moving to some new text and pressing a button; this makes a new selection. You can have only one selection at a time.

The major Word commands are listed at the bottom of the screen. To execute these commands, you point at them. Move to the letter "u" in "just" again and press the right button, so that the word "just" is selected. Now move to the bottom part of the screen and point at the word "Delete". Press the right button, and the word "just" will disappear from the text:

This is like a typewriter.

You have now executed the Delete command on the selected text. This is the most common way you will execute Word commands, although you will also often use the left mouse button; the difference between the two buttons is explained in the next chapter.

To see how Word inserts text, type the word not followed by a space. Word moves all the text to the right of your new characters, so that you always insert text at the selection.

This is not like a typewriter.

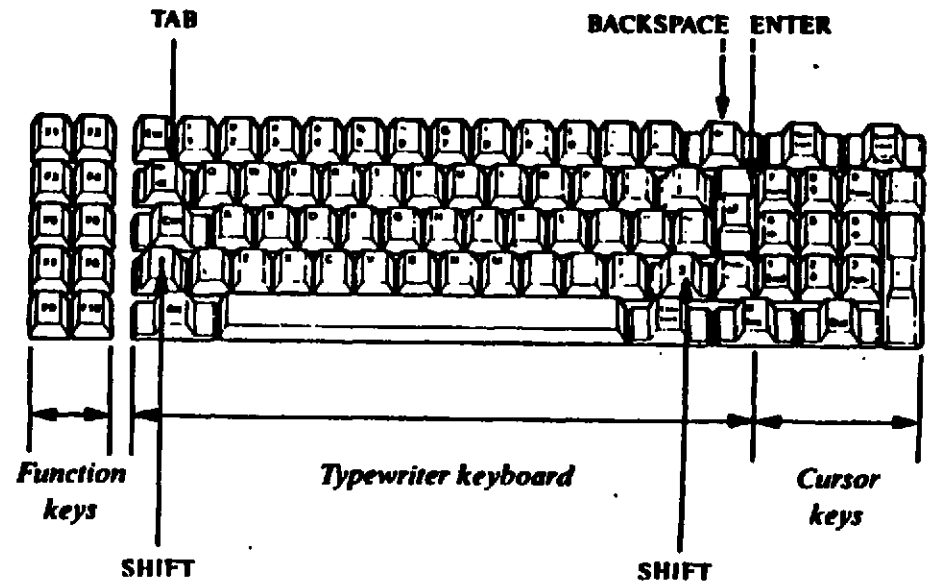
Giving Commands From the Keyboard

Word uses the IBM PC keyboard to give commands in much the same way as other word processing programs. Word uses the function keys (the gray keys marked F1, F2, and so on at the left side of the keyboard) and the cursor control keys (the arrow keys, PAGE UP, PAGE DOWN, and other keys at the right side of the key-

cursor, to identify text; however, since the keys on the right side of the keyboard are often called cursor control keys, that name has been retained in this book.

Even if you have a mouse, you will find that using the keyboard is faster than the mouse for some commands (such as Insert and Delete). Therefore, it is to your advantage to learn how to use both the mouse and the keyboard.

The ALT key and the CTRL key, which are on the left side of the main keyboard, are sometimes used in conjunction with other keys. You use the ALT key or the CTRL key somewhat like you use the SHIFT key when you type capital letters: you hold the ALT or CTRL key down first; then, while still holding the key down, press the other keys. You will often use other special keys, including the ESC key, the TAB key (marked with two arrows pointing at vertical lines), the ENTER key (marked with the arrow pointing down and then to the left; this is between the normal typewriter keys and the cursor keys on the right), the



BACKSPACE key (marked with the arrow pointing left, above the **ENTER** key), the **SCROLL LOCK** key (at the upper-right corner of the keyboard), the **DEL** key (near the lower right of the keyboard), and the **INS** key (next to the **DEL** key). The keys used for giving commands are shaded in the illustration.

You can use the arrow and function keys to give selection commands as you did with the mouse in the last section. (If you followed the directions there, you may want to restore the sentence to its original state. Point the mouse at the word "Undo" in the command menu and press the left button.) You can move the selection indicator around with the four arrow keys on the right side of the keyboard. Move the selection (the highlight) to the letter "u" in "just". Now press the **F7** key; this selects the word "just". Hold down the **SHIFT** key and then press the **F7** key; this selects the whole sentence. Notice that the selection indicator stretches to cover the amount of text selected.

To execute the Word commands listed at the bottom of the screen, first press the **ESC** key and then the first letter of the command you want to execute. When you press the **ESC** key, you will see the Alpha command highlighted at the bottom of the screen, and the second-to-last line will read "Select option or type command letter." (The Alpha command lets you enter and edit text; this is what you have already been doing.) Instead of typing the first letter of the command you want, you can use the — or — key to move among the commands. When you type the first letter of a command or move to it with the arrows, you are selecting that command. To execute the command, press the **ENTER** key.

For example, move the cursor over one of the letters in "just" and press **F7** to select the word. Now press **ESC**, type the letter **D** (for Delete), and press **ENTER**; this deletes the word. Unlike when you used the mouse, the Delete command gives you a choice of where you want to delete the selection to (the bottom

of the screen shows "DELETE to: |"); for now, just press the **ENTER** key when you see this (it is explained in full in Chapter 2).

ENTERING NORMAL TEXT

As you have seen, Word lets you enter text in a fairly normal fashion. When you type in text, you can correct typing mistakes by pressing the **BACKSPACE** key to erase the character to the left of the selection. If you later move the selection indicator to an error in the text you did not catch immediately, you can also use the Delete command to delete the selected characters.

Word treats all characters in your document (whether they are letters, numbers, or symbols) the same. The following sections discuss special symbols (for paragraphs, hyphens, and spaces) that Word treats as characters. Like normal text, you can insert them as you enter new text or when you edit.

Making Paragraphs in Word

In your text, each set of lines that is grouped as a unit is called a *paragraph*. This is, unfortunately, easy to confuse with the definition of a paragraph that you learned in grammar school, which is a group of sentences developing an idea. In Word, a paragraph is really just a line or group of lines that appear visually to be an independent unit. For instance, in a business letter, the line with the date, the lines that show the recipient's address, and the line with the salutation are all paragraphs, as is each group of sentences in the letter. When you see the word "paragraph" in this book and in the Microsoft Word reference manual, it will refer to Word's definition.

Word identifies the end of a paragraph by a special mark that it puts in your text when you press the ENTER key. For this reason, you do not use the ENTER key at the end of each line inside a paragraph. One of Word's features that makes typing much easier is automatic *wordwrap*, which prevents you from having to decide where to end each line. As you type in a paragraph, Word automatically figures out where to start a new line. You only press ENTER at the end of the paragraph.

If you want to force Word to start a new line within a paragraph (but not start a new paragraph), hold down the SHIFT key while you press the ENTER key. This key combination is called NEWLINE, and it lets you make lines of different lengths within a paragraph that are not like the lines of a paragraph made with wordwrap. The reason that you would use NEWLINE instead of starting a new paragraph is that many of Word's formatting commands pertain to the whole paragraph. If you signal a paragraph with ENTER, you have to format it; if you use NEWLINE, you only need to format the whole paragraph once.

A good example of using NEWLINE is in typing the recipient's address in a letter. You will learn in Chapter 13 how to see the difference between the end of a paragraph and NEWLINE; for now, it is not important.

GETTING HELP

Word's Help command is a quick way to get information about a command or to figure out what is happening in the program. The Help command has a menu of choices that you can use to get information about any command and all of its subcommands and choices.

You start the Help command by pointing with the mouse at "Help" on the screen and pressing the left mouse button, or by

pressing the ESC key and then the letter "H". You are presented with the following screen:

INTRODUCTION

Help information is available for Word commands and for the topics listed in the second command line below.

For specific information about a command:

Inside help, press PgDn until you find the information.

Outside help, move highlight to the command name or command field, then press Alt-h; or point to help mark and click a mouse button.

To move highlight in a menu, press Esc, then press spacebar or ←
To move highlight to a command field, press →

```
HELP: Resume Next Previous
      Introduction Commands Editing Keyboard Mouse Selection Tutorial
Select option or type command letter ?
Page 1 {}                                Microsoft Word:
```

The bottom lines show the choices offered by the Help command. You can choose "Next" to see the next screen of information or "Previous" to see the previous one. You can also choose one of the topics on the next line for information on a specific subject. When you are finished, choose "Resume" to continue with Word.

Word includes a full-featured tutorial on the Learning Word Disk. You can run the tutorial by itself or from within the Help command in Word.

If you are using the mouse, you can also get help by pointing at the command name or command field on the screen and

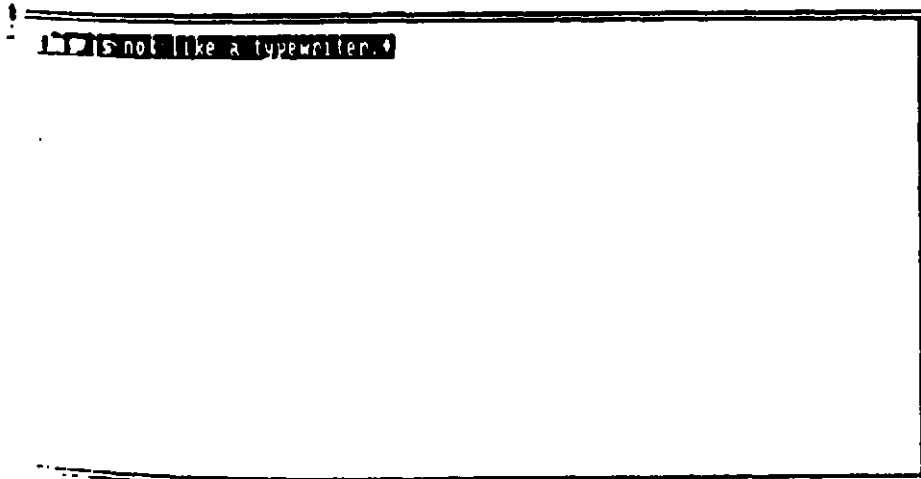
this will give you information about that command directly, so you do not have to go through the Help command's introduction. If you are editing, selecting the question mark will give you information on the last command you executed.

LEAVING WORD

Since you have only entered practice text, it is unlikely that you want to save it in a file (don't worry; the real text comes at the beginning of the next chapter). When you leave Word, the program checks to see if you have saved your text in a file before it returns you to PC-DOS. It is easy, however, to tell Word not to bother.

When you want to exit from Word and return to PC-DOS, give the Quit command. If there is text that you have not saved on disk (you will learn how to do this in the next chapter), Word will ask (at the bottom of the screen) the following:

If you want to save your text, type Y. In this case, however, you can type N, since the material is just for practice. If you realize that you want to do more editing, press the ESC key.



Reference 2.1

Microsoft Word

Word Command Summary

From Appendix

Microsoft Word Made Easy
1987

Appendix D

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Word Command Tree Summary

The following is a list of all Word commands available from the keyboard. Commands in boldface are those available on Word's top menu. Where specific answers are required, they are given in parentheses.

Alpha

Copy to:

Delete to:

Format

Character

bold (Yes/No)

italic (Yes/No)

underline (Yes/No)

striketrough (Yes/No)

uppercase (Yes/No)

small caps (Yes/No)

double underline (Yes/No)

position (Normal/Superscript/Subscript)

font name

font size

hidden (Yes/No)

Paragraph

alignment (Left/Centered/Right/Justified)

left indent

first line

right indent

line spacing

space before

space after

keep together (Yes/No)

keep follow (Yes/No)

Side by side (Yes/No)

Tabs

Set

position

alignment (Left/Center/Right/Decimal)

leader char (blank/./-/—)

Clear

Reset-all

Footnote reference mark:

Division

Margins

top

bottom

left

right

page length

width

gutter margin

running head position

from top

from bottom

Page-numbers

(Yes/No)

from top

from left

numbering (Continuous/Start)

at

number format (1/1/i/A/a)

Layout

footnotes (Same-page/End)

number of columns

space between columns

division break (Page/Continuous/Column/Even/Odd)

Running-head

position (Top/Bottom)

odd pages (Yes/No)

even pages (Yes/No)

first page (Yes/No)

Style

Characters

Paragraph

Division

Sheet

Gallery**Help****Insert from:****Jump to:**

Page

Footnote

Library

Autosort

by (Alphanumeric/Numeric)

sequence (Ascending/Descending)

case (Yes/No)

column only (Yes/No)

Hyphenate

confirm (Yes/No)

hyphenate caps (Yes/No)

Index

entry/page # separated by

cap main entries (Yes/No)

indent each level

use style sheet (Yes/No)

Number

Update/Remove

restart sequence (Yes/No)

Run DOS command**Spell**

Add

word to (Standard/Document/User)

Correct

adjust case (Yes/No)

Dictionary

Help

Ignore

Mark

Next

Options

lookup (Quick/Complete)

ignore all caps (Yes/No)

marking character

Previous

Proof

Quit

Resume

Table

index on

entry/page # separated by

indent each level

use style sheet (Yes/No)

Options

visible (None/Partial/Complete)
 printer display (Yes/No)
 menu (Yes/No)
 default tab width
 measure (In/Cm/P10/P12/Pt)
 mute (Yes/No)

Print

Printer
 Direct
 File
 Glossary
 Merge
 Options
 printer
 draft (Yes/No)
 queued (Yes/No)
 copies
 range (All/Selection/Pages)
 page numbers
 feed (Manual/Continuous/Bin1/Bin2/Bin3/Mixed)
 widow/orphan control (Yes/No)
 setup
 Queue (Continue/Pause/Restart/Stop)
 Repaginate
 confirm page breaks (Yes/No)

Quit**Replace**

text
 with text
 confirm (Yes/No)
 case (Yes/No)
 whole word (Yes/No)

Search

text
 direction (Up/Down)
 case (Yes/No)
 whole word (Yes/No)

Transfer

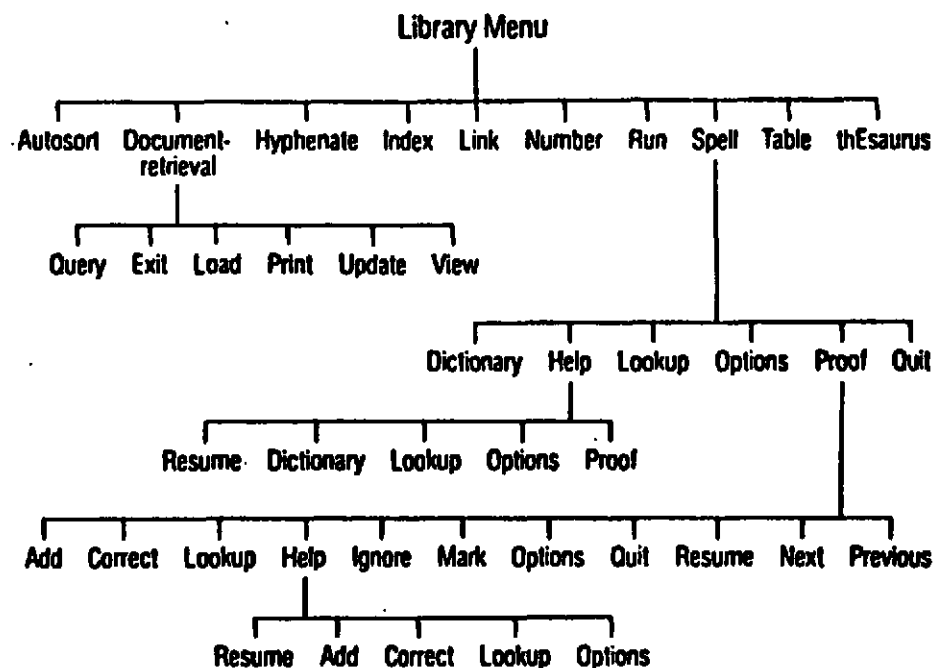
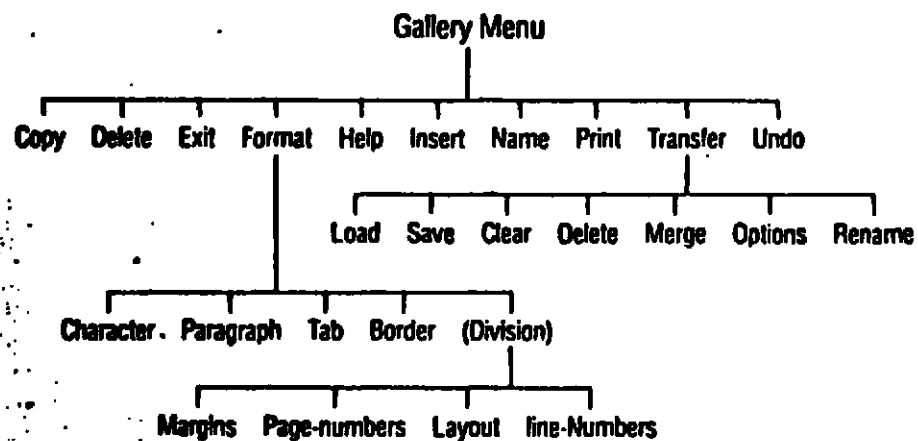
Load
 read only (Yes/No)
 Save
 formatted (Yes/No)
 Clear (All/Window)
 Delete
 Merge
 Options setup:
 Rename
 Glossary (Merge/Save/Clear)

Undo**Window**

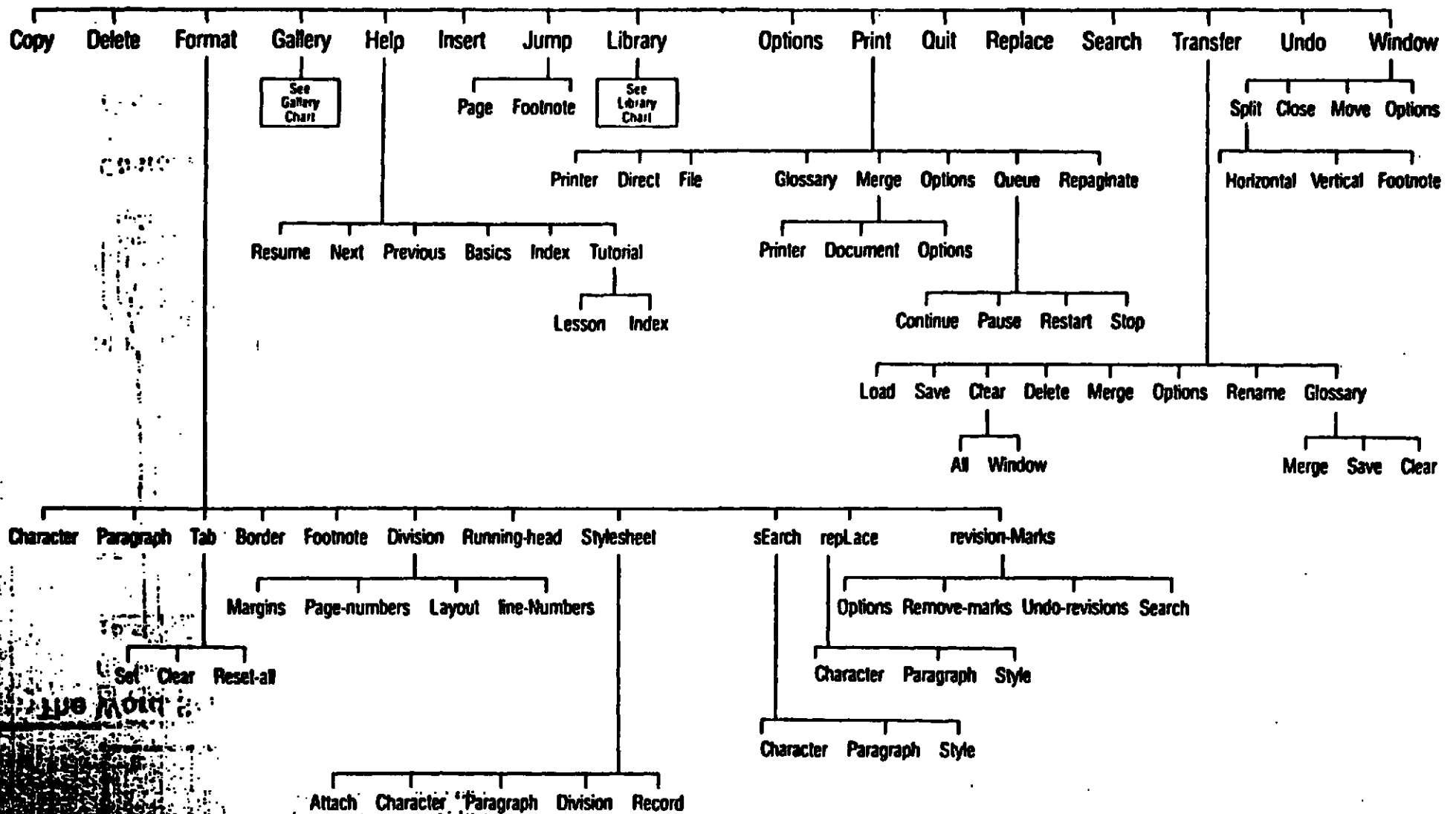
Split
 Horizontal
 at line
 clear new window (Yes/No)
 Vertical
 at line
 clear new window (Yes/No)
 Footnote
 at line
 Close
 window number
 Move
 window number
 to row
 to column

Options

window number
 outline (Yes/No)
 show hidden text (Yes/No)
 background color
 style bar (Yes/No)
 ruler (Yes/No)



Microsoft Word 4.0 Command Map.



Workshop A.02

Introduction to Layer-Based Computer-Aided Design:
AutoCAD

Introduction to Layer-Based Computer-Aided Design: *AutoCAD*

Objectives

1. To explore the capabilities of a layer-based microcomputer CAD system, in particular those of *AutoCAD, Release 10*.
2. To apply the key two-dimensional drafting features of AutoCAD to a floor plan and site plan of a simple building.
3. To not only replicate the drawing, but to understand how the graphics of the drawing were created and to be able to create them yourself.
4. To print an AutoCAD drawing on a laser printer.

This workshop assumes no familiarity with AutoCAD, or any CAD package for that matter. It does assume basic knowledge of microcomputer, or PC, use. You should have two formatted floppy diskettes with you on which to save your work. (Formatting can be done from DOS or is often available off a general menu system.) For graphics work, it is recommended that you use high-density diskettes, although it is not required for this workshop.

Important Note: There should be a copy of the AutoCAD User's Reference Manual not far from your work area. When you have a question while using AutoCAD, this is an incredibly helpful resource. It is written for a reason and should be used.

Procedure

1. Start AutoCAD.

A. AutoCAD's Main Menu

Depending on how your computers are set up, enter AutoCAD either from a general menu or by typing ACAD at a system prompt. The next screen image which confronts you is the AutoCAD Main Menu. Whenever you end an AutoCAD work session you will return to this menu. In addition to letting you enter the Drawing Editor, this menu helps you with file management, plotting of AutoCAD drawings, and other non-graphic tasks. For this workshop, we will be concerned with options 0 through 3. To begin a new drawing we will choose option 1. Follow the sequence below.

Main Menu

0. Exit AutoCAD
1. Begin a NEW drawing
2. Edit an EXISTING drawing
3. Plot a drawing
4. Printer Plot a drawing

5. Configure AutoCAD
6. File Utilities
7. Compile shape/font description file
8. Convert old drawing file

Enter selection: 1

Enter NAME of drawing: ANDO

AutoCAD is not case sensitive, so whether you refer to this ANDO drawing as "ANDO" or "ando" does not matter.

B. The Project and AutoCAD's Drawing Editor

For this workshop you will draw a plan of a chapel on Mt. Rokko in Kobe, Japan. The architect is Tadao Ando. This particular building was chosen so that you could become familiar, in a relatively short exercise, with the most relevant functions of AutoCAD. The result will be a simplified 2D drawing of the building and site plan. (AutoShade, the "3D" module of AutoCAD, is covered in another workshop.) Apologies should be made to Mr. Ando for the necessary oversimplification of the building design for this exercise. Given more time the Mt. Rokko Chapel could be detailed more accurately using AutoCAD.

You have just entered the AutoCAD's Drawing Editor. Take a look at how your screen is divided and what information is available to you. Locate the following:

Center:	Graphics Area
Upper left:	Status Line, including current layer name (default is layer 0)
Upper right:	Position Indicator
Right:	Screen Menu
Bottom:	Command Line, prompt is <i>Command:</i>
Bottom left:	User-Coordinate System icon, indicating positive X and Y directions
Cursor:	Cross-hairs

The User-Coordinate System (UCS) icon can be turned off if you become annoyed with it. Type *UCSICON* at the *Command:* prompt and answer *OFF* to the options available. For the meantime, you may want to leave it on while you become familiar with the X-Y coordinate system.

C. Function Keys

(Hit the F1 key. Hit it again.)

There are some function keys on your keyboard which have been preprogrammed by AutoCAD to do useful things. The *F1* key is the toggle between Text and Graphic modes. Watch the position indicator on the upper right of your screen as you move the mouse around.

(Now click the F6 key and move the mouse around.)

The *F6* key turns your coordinate display on and off. Try the other function keys:

F1:	Text/Graphic
F6:	Coordinates
F7:	Grid
F8:	Ortho
F9:	Snap

For the following example and the entirety of this workshop, a description of an AutoCAD function or a workshop task is followed by a command sequence. First read through the description. Then follow the command sequence. If a command or response is in **BOLD** type, you should enter it exactly as it is written here. If an italicized comment or set of instructions is included in parentheses (as in the example of function keys above), you are requested to follow the instructions and perform the necessary actions.

D. **HELP** Command, Repeat Commands and Cancel Commands

The **HELP** command gives you onscreen information about a specific command. To use it simply follow the prompts.

Command: **HELP**
Command name (RETURN for list): **PLINE**
(AutoCAD gives us information about the **PLINE** command. Hit the **F1** key to get back to graphic mode.)

To repeat your last command hit the **RETURN** key. The space bar and the right mouse button work just like the **RETURN** key.

Command: **RETURN** (i.e., hit the Return/Enter key. This will repeat the **HELP** command.)
Command name (RETURN for list): **LINE**
(Press **F1** to flip to the graphics screen.)

If you are in the middle of a command and want to cancel out of it, hit **Ctrl-C** (the **Ctrl** key held down with the **C** key). AutoCAD will not understand a command unless you enter it after the **Command:** prompt.

Command: **LINE**
From point: (Hit **Ctrl-C** to cancel the **LINE** command.) *Cancel*
Command:
(Notice that this returns you to the **Command:** prompt.)

3. Set Up the Drawing

A. Set the Drawing's Default Units

For this workshop we will use the English units of feet and inches for measuring. To do this we must alert AutoCAD to our decision using the **UNITS** command. Before you begin, however, there are two points we need to make. They are incredibly useful tidbits of knowledge, yet no matter how much I try to accentuate them, people generally do not remember. Please try:

*** Any default values are indicated between the < > symbols. If you wish to keep the default value, just hit the **RETURN** key and continue.

*** Some commands (such as the following **UNITS** command) will automatically flip your screen to text mode. To return to the graphics screen after this occurs, hit the **F1** key or type **REDRAW**.

Command: UNITS	
System of units:	(Examples)
1. Scientific	1.55E+01
2. Decimal	15.50
3. Engineering	1'-3.50"
4. Architectural	1'-3 1/2"
5. Fractional	15 1/2

With the exception of Engineering and Architectural modes, these modes can be used with any basic unit of measurement. For example, Decimal mode is perfect for metric units as well as English units.

Enter choice, 1 to 5 <4>: 4

Denominator of smallest fraction to display (1,2,4,8,16,32, or 64) <8>: 16

Systems of angle measure:	(Examples)
1. Decimal degrees	45.0000
2. Degrees/minutes/seconds	45d0'0"
3. Grads	50.0000g
4. Radians	0.7854r
5. Surveyor's units	N 45d0'0" E

Enter choice, 1 to 5 <1>: 1

Number of fractional places for display of angles (0 to 8) <2>: 2

Direction for angle 0.00:

East	3 o'clock = 0.00
North	12 o'clock = 90.00
West	9 o'clock = 180.00
South	6 o'clock = 270.00

Enter direction for angle 0.00 <0.00>: RETURN

Do you want angles measured clockwise? <N> RETURN

Command: REDRAW

B. Determine and Set the Drawing's Limits

You now must determine the drawing "limits". In AutoCAD, the limits indicate a boundary in which your drawing should stay, and are defined by two points using absolute Cartesian coordinates. Set with the *LIMITS* command, these points locate two diagonal corners of a rectangular area.

The following limits were chosen based on the dimensions of the site. (Refer to the final sheet of this workshop for the intended result.) Our site is approximately 175' by 105'. After deciding that our origin (0,0) will be at the lower left corner of the site, and allowing for a margin of 10' all around, we come up with the following limits. You can always change the limits later if your initial setting becomes inappropriate.

Command: LIMITS

ON/OFF/<Lower left corner> <-1'-0",-1'-0">: -10',-25'

Upper right corner <100'-0",75'-0">: 185',100'

Keep in mind that while working with AutoCAD you will be drawing in real scale. This means that if a wall is 10' long, you simply tell AutoCAD that you want to draw a 10' line. Simple, no? This is as opposed to drawing a 2 1/2" line because you are working at a scale of 1/4"=1'-0". With AutoCAD, the scale of the plotted drawing is determined at plot time so that you can plot this one drawing at as many scales as you need. In the meantime, you will always be drawing in this real scale.

Also, be sure to type the ' (foot symbol) when indicated, as AutoCAD will assume that you mean inches if no unit of measurement is indicated.

C. Cursor Controls - SNAP and GRID

AutoCAD allows you to set up a grid as a visual aid for dimensioning. You can specify the grid spacing as you want and, similar to limits, it can always be changed. For now, it will be set to a ten-foot spacing.

Command: GRID

Grid spacing(X) or ON/OFF/Snap/Aspect <2'-0">: 10'

In a similar fashion we will activate the snap option. AutoCAD gives you control over the distance the cursor moves. Slide the cursor around the graphic area. If the snap is turned off (*F9* key), you will notice that the cursor moves quite freely. The *SNAP* command will force the cursor to move a specified distance.

Command: SNAP

Snap spacing or ON/OFF/Aspect/Rotate/Style <1'-0">: 5'

Use the *ZOOM All* command to display your entire drawing area as defined by the *LIMITS* command.

Command: ZOOM

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: A (*for All*)

Now if you slide the cursor around, it will snap to five-foot increments. If the grid is set to ten-foot increments, as it currently should be, the cursor snaps to grid points and half-way between grid points. Note how these two commands are dependent and independent of each other.

(Hit the F7 key to make the grid invisible. Move the cursor.)

It should still snap to five foot increments.

(Hit the F7 key again.)

D. Create and Modify Layers

AutoCAD is a layer-based system. A layer is analogous to an overlay on which you keep various types of information. In a floor plan of a building, for example, you want to keep the walls, doors, furniture, electrical, and other data separated so that you can plot them separately or in different combinations.

Each layer has a unique name and is assigned a color and linetype. There are seven standard colors: red, yellow, green, cyan, blue, magenta, and white. And, there are eight standard linetypes: continuous, dashed, hidden, center, phantom, dot, dashdot, border, and divide. This drawing will use six layers.

<u>Layer Name</u>	<u>Color</u>	<u>Linetype</u>
Bound	Red	Border
Wall	White	Continuous
Door	Cyan	Continuous
Land	Green	Dot
Over	Blue	Dashed
Furn	Magenta	Continuous

The *LAYER* command creates and modifies drawing layers. Since by default any new layer is white and has a continuous linetype, you must use the *LAYER* command to assign any modifications to that layer. Note the protocol for this command:

1. *Specify your intended action:* create a New one or change a Color or turn it ON or OFF, etc.
2. *Indicate the layer(s) upon which you want to act:* WALL or 0 or LAND,OVER,FURN or * (to indicate all layers), etc.

To list several layers on one line, separate the names with a comma and no spaces, as indicated below. AutoCAD will keep you in the *LAYER* command so that you can perform multiple tasks. After all actions are completed related to layers, hit the RETURN key at the *LAYER* prompt. Follow the next sequence to understand the entire arrangement.

Command: **LAYER**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: N (to create a New layer)

New layer name(s): **BOUND,WALL,DOOR,LAND,OVER,FURN**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: C (to change the Color of a chosen layer)

Color: **RED**

Layer name(s) for color 1 (red) <0>: **BOUND**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: C (for Color)

Color: **CYAN**

Layer name(s) for color 4 (cyan) <0>: **DOOR**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: C (for Color)

Color: **GREEN**

Layer name(s) for color 3 (green) <0>: **LAND**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: C (for Color)

Color: **BLUE**

Layer name(s) for color 5 (blue) <0>: **OVER**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: C (for Color)

Color: **MAGENTA**

Layer name(s) for color 6 (magenta) <0>: **FURN**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: L (to change the Linetype of a chosen layer)

Linetype (or ?) <CONTINUOUS>: **BORDER**

Layer name(s) for linetype BORDER <0>: **BOUND**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: L (for Linetype)

Linetype (or ?) <CONTINUOUS>: **DOT**

Layer name(s) for linetype DOT <0>: **LAND**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: L (for Linetype)

Linetype (or ?) <CONTINUOUS>: **DASHED**

Layer name(s) for linetype DASHED <0>: **OVER**

E. List the Layers

To get a list of your layer setup, type ? at the layer prompt. Then use the wildcard option, *, to indicate all layers.

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: ? (to list the layers)

Layer name(s) for listing <*>: * (to list all the layers)

Check to see that your layers have been entered correctly.

F. Set the Current Layer

The creation of layers and assignment of colors and linetypes is now complete. Before you start drawing you must set the current layer. The current layer is that layer upon which you will draw. There is always one from your list which is considered current and it is indicated in the upper left corner of the screen should you forget. If you are drawing doors, it is up to you to make sure that the DOOR layer, not the TREE layer, is current. Since you will first draw the boundary of the site, set the BOUND layer as current.

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: S (to Set the current layer)
New current layer <0>: BOUND
?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: RETURN
Regenerating drawing.

Notice that the layer name at the upper left corner (which was 0 before) is now changed to BOUND. Also, the word SNAP next to the current layer name indicates that the snap option is on.

4. Begin to Draw.

A. Draw the Site Boundary with Relative Coordinate Entry

You will draw the site boundary using the *PLINE* command. In AutoCAD, *PLINE* stands for polyline. This signifies a series of contiguous line segments considered to be one entity.

We can indicate locations within the XY Cartesian coordinate system several ways: mouse hits, absolute coordinates, and relative coordinates. For the site boundary lines we will use relative coordinates as indicated by the @ symbol before each coordinate entry. The @ symbol tells AutoCAD to measure *relative to the last point entered* as opposed to relative to the absolute origin (0,0) of the drawing. The third segment uses relative polar coordinates. (Further on, you will use absolute coordinates so that you will be able to compare the difference.)

(Turn off the grid and snap options by hitting the F7 and F9 keys. We will use these later while drawing the building's floor plan.)

Notice the *Undo* option within the *PLINE* command below. If you enter a coordinate incorrectly, simply type a *U* at the next prompt and the previous segment will be erased. You can then continue with the *PLINE* command. Otherwise, enter the following measurements (in **BOLD**) exactly as they appear.

Command: PLINE
From point: 0,0
Current line-width is 0'-0"
Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: @0,90'
Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: @175',0
Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: @100'<260
Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: CLOSE

For the third segment you drew a line 100 feet long at an angle of 260 degrees. AutoCAD measures degrees counterclockwise, beginning with 0 degrees at 3 o'clock, or to the east. The *CLOSE* option simply locates the final segment's endpoint coincident with the first segment's start point. Notice that your boundary line should have the color RED and the linetype BORDER which we set previously.

Use the *LTSCALE* command to adjust the linetype scale. A scale factor of 30 will be appropriate for this size site plan and will give you a nice proportion of dashes, dots and spaces for your final plot. If the *LTSCALE* were set to 1, the dashes and dots would be so close as to appear continuous. Normally the drawing will automatically regenerate when the linetype scale is changed. If it does not, type *REGEN* at the next prompt.

Command: LTSCALE
New scale factor <40.0000>: 30

B. Viewing Options - ZOOM

The **ZOOM** command gives us several options for viewing our drawing on the screen. **HELP Zoom** gives us a list and description of these.

Command: **HELP**

Command name (RETURN for list): **ZOOM**

(Read the screen and press F1.)

Toggle between **ZOOM All** and **ZOOM Extents** to see the difference between the two.

Command: **ZOOM**

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: **E** *(for Extents)*

Command: **RETURN**

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: **A** *(for All)*

Command: **RETURN**

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: **E** *(for Extents)*

(Try ZOOM Window and ZOOM Previous. Then try PAN and ZOOM Dynamic. If you have problems, and no one is around to demonstrate, type Ctrl-C to cancel the command and continue with the workshop.)

C. Draw the Building Outline

In order to draw the building plan we will (1) reset the grid and snap spacings, (2) make the coordinates display active, and (3) draw the plan using onscreen relative coordinates. Initially we will draw just an outline. We also need to set the current layer to **WALL**.

Command: **ZOOM**

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: **E** *(for Extents)*

Regenerating drawing.

Command: **LAYER**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: **S** *(to Set the current layer)*

New current layer <BOUND>: **WALL**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: **RETURN**

Command: **GRID**

Grid spacing(X) or ON/OFF/Snap/Aspect <10'-0">: **1'8**

Command: **SNAP**

Snap spacing or ON/OFF/Aspect/Rotate/Style <5'-0">: **10**

(Snap, grid, and coordinates display should be on. Use the F7, F9 and F6 keys, respectively, if they are not.)

It will be easier to click on the necessary grid points if you zoom in on that area.

Command: **ZOOM**

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: **W** *(for Window)*

First corner: **15',22'**

Other corner: **75',65'**

For the following commands, remember to use the left mouse button to pick something off the screen. In the following example, click when the given coordinates are displayed at the upper right hand corner of the screen.

(Hit the F8 key to turn on Ortho mode.)

Command: **PLINE**

From point: *(Click at the coordinate 24'-2",29'-2")*

Current line-width is 0'-0"

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: *(Click at 25'-10" < 90.00)*

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: *(Click at 39'-2" < 0.00)*

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: *(Click at 0'-10" < 90.00)*

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: *(Click at 2'-6" < 180.00)*

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: *(Click at 5'-0" < 90.00)*

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: *(Click at 6'-8" < 0.00)*

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: *(Click at 31'-8" < 270.00)*

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: **C** *(for Close)*

D. Give the Walls a Thickness with the **OFFSET** Command

Using the **OFFSET** command, you can give a preset thickness to the walls. Here you will set a 10" wall. Note that the default is set for *Through* (which means you would indicate the offset with your cursor) Once you change the default to 10", this command will **OFFSET** the entity 10 inches. As mentioned previously, if you want to use the default value, simply hit the **RETURN** key.

Command: **REDRAW**

Command: **OFFSET**

Offset distance or Through <Through>: **10**

Select object to offset: *(Click on any of the wall line segments.)*

Side to offset? *(Click anywhere outside the walls of the plan.)*

Select object to offset: **RETURN**

E. Draw the Courtyard Walls

Since we know the courtyard wall lengths are 20' and 75', respectively, relative coordinate entry is appropriate.

Command: **ZOOM**

All/Center/Dynamic/Extents/Left/Previous/Window/Scale(X)>: **E** *(for Extents)*

Command: **PLINE**

From point: **29',55'10**

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: **@0,20'**

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: **@75',0**

Arc/Close/Halfwidth/Length/Undo/Width/Endpoint of line>: **RETURN**

Command: **OFFSET**

Offset distance or Through <0'-10">: **RETURN**

Select object to offset: *(Click on the courtyard wall.)*

Side to offset? *(Click below the wall.)*

Select object to offset: **RETURN**

F. Object Snap Commands

(Turn Grid and Snap off with the F7 and F9 keys.)

In addition to the **SNAP** command, AutoCAD has object snaps. A list of these "osnap" options is available by clicking on the asterisks (****) at the top of the screen menu. The osnaps allow us to snap the cursor to exact locations on an existing entity. As an example, we will use the **ENDpoint** option to finish up the end of the courtyard wall.

Command: **ZOOM**

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: **W** *(for Window)*

First corner: *(Referring to the diagram, click point A.)*

Other corner: *(Click point B.)*

Command: **LINE**

From point: *(Click **** off the screen menu and choose ENDpoint. Click at point C.)*

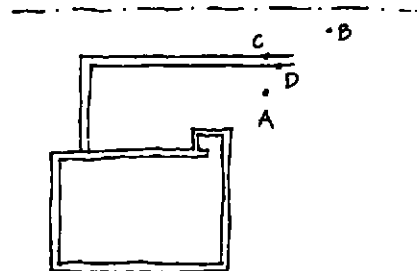
To point: *(Click **** and ENDpoint again. Then click at point D.)*

To point: **RETURN**

Command: **ZOOM**

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: **E** *(for Extents)*

Regenerating drawing.



G. Draw Doors with ARC, MIRROR and BREAK

Now the chapel needs a set of double doors at the back of its main space. First work on the doors, then make the appropriate edits on the wall.

Command: **LAYER**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: **S** *(to Set the current layer)*

New current layer name <WALL>: **DOOR**

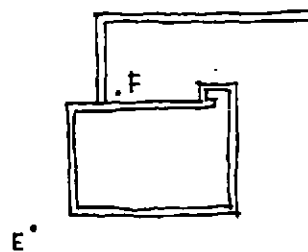
?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: **RETURN**

Command: **ZOOM**

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: **W** *(for Window)*

First corner: *(Click point E.)*

Other corner: *(Click point F.)*



Wall spacing may not appear accurate, but in "reality" it is. Screen resolution is the problem.

Command: **LINE**

From point: *(Choose **** and MIDpoint. Click on point G.)*

To point: *(Choose **** and PERpendicular and click on point H.)*

To point: **RETURN**

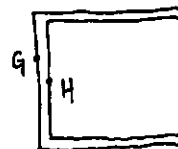
Command: **COPY**

Select objects: **L** *(for Last object)*

Select objects: **RETURN**

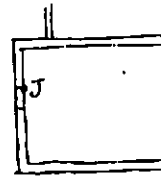
<Base point or displacement>/Multiple: *(Click anywhere.)*

Second point of displacement: **@0,3'**

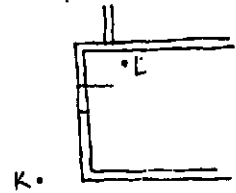


Command: **REDRAW**

Command: LINE
 From point: (Choose **** and ENDpoint. See diagram and click J.)
 To point: @3',0
 To point: RETURN

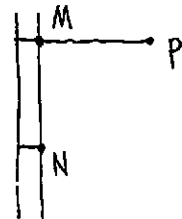


Command: ZOOM
 All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: W (for Window)
 First corner: (Click point K.)
 Other corner: (Click point L.)



There are many ways to draw an arc. Refer to the reference manual for all of the options AutoCAD gives you. For this door swing we will use the CSE option which means we will supply the Center, the Startpoint, and the Endpoint. Remember that positive angles are measured in the counterclockwise direction.

Command: ARC
 Center/<Start point>: C (for Center)
 Center: (Choose **** and INTERsect. Click M.)
 Start point: (Choose ENDpoint. Click N.)
 End point: (Choose ENDpoint. Click P.)

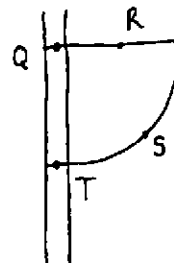


Command: REGEN

Make sure you are in ORTHO mode by checking the Status Line on the screen.

(Hit the F8 key if the ORTHO is off.)

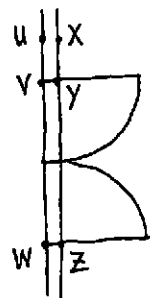
Command: MIRROR
 Select objects: (Click points Q, R and S.) 1 selected, 1 found.
 Select objects: 1 selected, 1 found.
 Select objects: 1 selected, 1 found.
 Select objects: RETURN
 First point of mirror line: (Choose ENDpoint. Click at T.)
 Second point: (Click anywhere to the right. A mirrored image of the door will appear.)
 Delete old objects? <N> RETURN



Command: SNAP
 Snap spacing or ON/OFF/Aspect/Rotate/Style <1'-0">: 1"

Command: BREAK
 Select object: (Click at U.)
 Enter second point (or F for first point): F (to indicate First point)
 Enter first point : (Click at V.)
 Enter second point: (Click at W.)

Command: BREAK
 Select object: (Click at X.)
 Enter second point (or F for first point): F (to indicate First point)
 Enter first point : (Click at Y.)
 Enter second point: (Click at Z.)



Since we do not need it anymore, we can now eliminate the small construction line at the end of the door swings.

Command: ERASE

Select objects: *(Click at on center horizontal line.)* 1 selected, 1 found.

Select objects: RETURN

Note that the jamb lines appear in the DOOR layer instead of the WALL layer. We will change that later. For now, let's step back and see what we have done so far.

Command: ZOOM

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: E *(for Extents)*

5. End a Work Session - *SAVE, QUIT, END.*

So far, you have not yet saved your drawing. You should do that now. If you don't, and if there were a catastrophic earthquake or if someone tripped over your machine's power cord or if your machine crashed for one of a billion reasons, none of your work would be saved and you would have to begin again as if you had done nothing. This is not fun. Believe me.

The *SAVE* command saves your drawing, without exiting the Drawing Editor.

The *QUIT* command exits you to the Main Menu but DOES NOT SAVE your work.

The *END* command saves your drawing and exits you to the main menu.

During any work session you should *SAVE* every 15 minutes. It usually takes no more than a few seconds. You always have time to *SAVE*.

Command: SAVE

File name <ANDO>: RETURN *(to accept the default filename)*

With the *SAVE* command, you could also specify a filename other than the default given. For example, typing A:ANDO to the filename prompt would save ANDO.DWG on a floppy in A: drive.

Command: QUIT

Really want to discard all changes to drawing? N

You will only use the *QUIT* command if, after working on a drawing, you have decided that you do not want to save any of the edits. The above prompt will always ask if you are sure of your action.

Command: END

6. Edit an Existing Drawing

A. Main Menu - Option 2

When you want to edit an existing drawing, re-enter the AutoCAD Drawing Editor by selecting 2 from the Main Menu.

Main Menu

0. Exit AutoCAD

1. Begin a NEW drawing

2. Edit an EXISTING drawing

3. Plot a drawing

4. Printer Plot a drawing

5. Configure AutoCAD
6. File Utilities
7. Compile shape/font description file
8. Convert old drawing file

Enter selection: 2

Enter NAME of drawing <default ANDO>: ANDO

B. Draw the Entry Colonnade with COPY and ARRAY

AutoCAD provides us with a few editing commands which allow us to more quickly draw repetitive elements. Since the colonnade is actually multiple copies of a few simple entities, we can draw the base elements, then *COPY* and *ARRAY* them for our needs. First we will draw a column in the WALL layer.

Command: LAYER

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: S (to Set the current layer)

New current layer <DOOR>: WALL

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: RETURN

Command: PLINE

From point: 8',25'

Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: @10,0

Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: @0,-10

Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: @-10,0

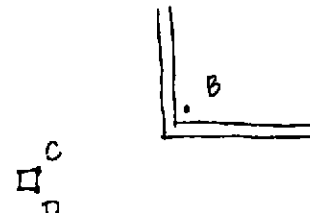
Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: C (to Close)

Command: ZOOM

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: W (for Window)

First corner: (Click point A.)

Other corner: (Click point B.)



Now draw two lines indicating the overhead beam.

Command: SNAP

Snap spacing or ON/OFF/Aspect/Rotate/Style <1'-0">: 2

Command: LAYER

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: S (to Set the current layer)

New current layer <WALL>: OVER

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: RETURN

Command: LINE

From point: (Click at point C.)

To point: @8'2,0

To point: RETURN

Command: COPY

Select objects: (Click on last line drawn.) 1 selected, 1 found.

Select objects: RETURN

<Base point or displacement>/Multiple: (Click on point C.)

Second point of displacement: (Click at point D.)

[illegible]

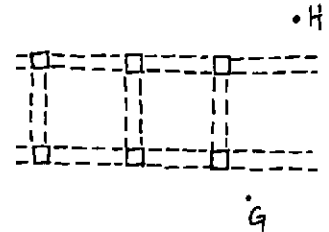
Distance between columns (III): 9'

Second point of displacement: @10,0

Regenerating drawing.

To erase the extraneous beams at the end of the colonnade use the *ERASE* command. The *C* option, which stands for Crossing, is similar to the Window option. *Window* chooses an entity if, and only if, it is entirely enclosed within the window. *Crossing* chooses all entities which are entirely within the window *or* cross the window at any point.

Command: **ERASE**
 Select objects: *C (for Crossing)*
 First corner: *(Click at G at far right end of colonnade.)*
 Other corner: *(Click at H.)* 4 found.
 Select objects: **RETURN**

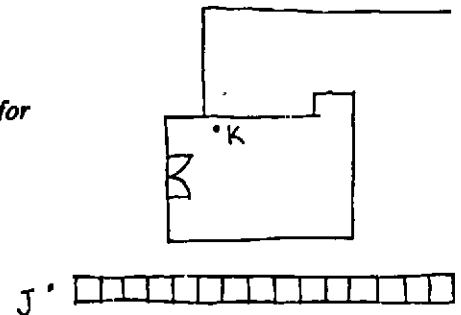


C. Draw an Arc with *PLINE*

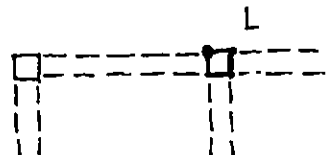
We will now draw the hinge piece between the entry and the main chapel space. *PLINE*'s line and arc options are very helpful here.

Command: **LAYER**
 ?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: *S (to Set the current layer)*
 New current layer <OVER>: **WALL**
 ?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: **RETURN**

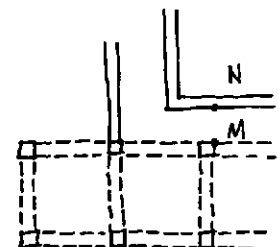
Command: **ZOOM**
 All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: *W (for Window)*
 First corner: *(Click at point J.)*
 Other corner: *(Click at point K.)*



Command: **PLINE**
 From point: *(Click at L.)*
 Current line-width is 0'-0"
 Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: *@17' <90*
(Remember our polar coordinates? @17' <90 means go 17 feet at an angle of 90 degrees, or up.)
 Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: *A (to draw an arc connected with and tangent to the previous line)*
 Angle/Ceater/CLOSE/Direction/Halfwidth/Line/Radius/Secondpt/Undo/Width/<Endpoint of arc>: *@6'4,6'4*
 Angle/Ceater/CLOSE/Direction/Halfwidth/Line/Radius/Secondpt/Undo/Width/<Endpoint of arc>: **RETURN**



Command: **LINE**
 From point: *(Click at M.)*
 To point: *(Click at N.)*
 To point: **RETURN**



Command: **OFFSET**
 Offset distance or Through <0'-10">: **10**
 Select object to offset: *(Click on line just drawn.)*
 Side to offset? *(Click to the left of it.)*
 Select object to offset: *(Click on the polyline with the arc.)*
 Side to offset? *(Click to the right of it.)*
 Select object to offset: **RETURN**

Command: **ZOOM**
 All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: *E (for Extents)*
 Regenerating drawing.

HAVE YOU SAVED YOUR WORK RECENTLY?

Don't forget and don't wait to be told. Just type **SAVE** and **RETURN** at the filename prompt.

D. Use the **MOVE** Command to Locate Benches

We will now draw one bench to the right of the chapel. We will **ARRAY** the one bench to make ten of them. Then, with the **MOVE** command, we will locate all of them inside the chapel.

Command: **LAYER**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: S (to Set the current layer)

New current layer <WALL>: FURN

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: RETURN

Command: **PLINE**

From point: (Click in outdoor space to the right of the chapel.)

Current line-width is 0'-0"

Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: @8'<90

Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: @1'6<0

Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: @8'<270

Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: C (to Close)

Command: **ARRAY**

Select objects: (Click on bench.) 1 selected, 1 found.

Select objects: RETURN

Rectangular or Polar array (R/P): R (for Rectangular array)

Number of rows (---) <1>: 2

Number of columns (||) <1>: 5

Unit cell or distance between rows (---): 12'

Distance between columns (||): 2'6

Command: **MOVE**

Select objects: W (for Window)

First corner: (Click two points to form a window which encloses all the benches, but nothing else.)

Other corner: 10 found.

Select objects: RETURN

Base point or displacement: (Click anywhere near the benches.)

Second point of displacement: (By dragging the benches with your mouse, locate them centrally in the chapel. If ORTHO mode is on, hit the F8 key to give yourself more flexibility with the move.)

E. Some Quick Trees with the **CIRCLE** Command

There are many ways to draw a circle. Experiment with some of the options while putting some rather simple, but quick, trees on the site.

Command: **LAYER**

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: S (to Set the current layer)

New current layer <FURN>: LAND

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: RETURN

Command: **SNAP**

Snap spacing or ON/OFF/Aspect/Rotate/Style <1'-0">: 2'

Command: **CIRCLE**

3P/2P/TTT/<Center point>: (Refer to final drawing for general location of trees. Click anywhere for the center of your first tree.)

Diameter/<Radius>: 10'

Remember that if you hit the *RETURN* key, AutoCAD will assume you would like to re-execute the previous command.

Command: *RETURN* (to repeat the *CIRCLE* command)

3P/2P/TTR/<Center point>: (Locate the center of another tree.)

Diameter/<Radius>: (This time drag the radius with your mouse to the desired size and click.)

Continue adding trees. Try the other *CIRCLE* options. For example, if you want to draw a circle by indicating three points on the circumference, then type *3P* at *CIRCLE*'s first prompt. Follow the instructions.

F. Change the Layer of an Object

One more thing. We must go back to the entry doors to the chapel and change the layer of the jambs. Drawing things in the wrong layer is a common problem if you fail to *LAYER* Set properly. To fix it, *Zoom* Window to the door and *CHANGE* the layer of those entities. Only use the *CHANGE* Property *LAYER* command. DO NOT use *CHANGE* Property Color or *LType*. This is important.

Command: *Zoom*

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: *W* (for *Window*)

First corner: (Click two points to form a window around the doors.)

Other corner:

Command: *CHANGE*

Select objects: (Click on the two door jambs.) 1 selected, 1 found.

Select objects: 1 selected, 1 found.

Select objects: *RETURN*

Properties/<Change point>: *P* (for *Properties*)

Change what property (Color/Elev/Layer/LType/Thickness)? *LA* (for *LAYER*)

New layer <LAND>: *WALL*

Change what property (Color/Elev/Layer/LType/Thickness)? *RETURN*

The two lines have been transferred to the *WALL* layer and now take on the *WALL* layer characteristics, i.e., continuous white lines.

Command: *Zoom*

All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: *E* (for *Extents*)

7. Plot a Drawing.

A. Make a Border

Before plotting your drawing, it is a good idea to fit your drawing to a 7.83" x 10.50" proportional format. This is a guide for the maximum plot area of an 8.5" x 11" sheet. To do so, you will draw a border of these dimensions and scale it until your drawing fits. First add another layer and set it as current.

Command: *LAYER*

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: *N* (to create a New layer)

New layer name(s): *BORDER*

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: *C* (to change the Color of a chosen layer)

Color: *YELLOW*

Layer name(s) for color 2 (yellow) <LAND>: *BORDER*

?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: S (to Set the current layer)
New current layer <LAND>: BORDER
?/Make/Set/New/ON/OFF/Color/Ltype/Freeze/Thaw: RETURN

Command: PLINE
From point: 0,0
Current line-width is 0'-0"
Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: 10.5,0
Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: 10.5,7.83
Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: 0,7.83
Arc/Close/Halfwidth/Length/Undo/Width/<Endpoint of line>: C

B. Fit the Border to the Drawing

Notice the small yellow rectangle at the bottom left corner of the screen; this is your border. Always scale the border to fit the drawing, not the building to fit the border. Using the *SCALE* command, enlarge and relocate the border to enclose the site plan.

Command: SNAP
Snap spacing or ON/OFF/Aspect/Rotate/Style <1'-0">: 12"

Command: ZOOM
All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: W (for Window)
First corner: -1',-1'
Other corner: 1',9

Command: SCALE
Select objects: (Click on the border polyline.) 1 selected, 1 found.
Select objects: RETURN
Base point: (Choose *END*point and click on the upper right hand corner of the border.)
<Scale factor>/Reference: 220

Command: ZOOM
All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: A (for All)

(If the *ORTHO* is on, hit *F8* to turn it off.)

Command: MOVE
Select objects: P (for Previous selection set)
Select objects: RETURN
Base point or displacement: (Choose *INTER*section and click at the lower left corner of the border.)
Second point of displacement: (Click when the border surrounds your building, similar to the example on the last page of this workshop.)

Before exiting, *ZOOM Extents* so that the drawing extents will fill the page without an extra border. The printer leaves its own border of approximately half an inch all around. *SAVE* the drawing to your floppies.

Command: ZOOM
All/Center/Dynamic/Extents/Left/Previous/Window/<Scale(X)>: E (for Extents)
Regenerating drawing.

Command: SAVE
File name <ANDO>: A:ANDO

Command: END

C. Create a Plot File

The AutoCAD Main Menu should be on the screen and one of your floppy disks should be in the A: drive. Since your drawing is ready to plot, choose option 3 from the menu list and answer the questions using the following sequence as a guide.

Main Menu

- 0. Exit AutoCAD
- 1. Begin a NEW drawing
- 2. Edit an EXISTING drawing
- 3. Plot a drawing
- 4. Printer Plot a drawing

- 5. Configure AutoCAD
- 6. File Utilities
- 7. Compile shape/font description file
- 8. Convert old drawing file

Enter selection: 3

Enter NAME of drawing: ANDO

Specify the part of the drawing to be plotted by entering:

Display, Extents, Limits, View, or Window <W>: E *(as defined by the last ZOOM Extents)*

Plot will be written to a selected file

Sizes are in Inches

Plot origin is at (0.00,0.00)

Plotting area is 7.83 wide by 10.50 high (MAX size)

2D Plots are rotated 90 degrees clockwise

Pen width is 0.001

Area fill will NOT be adjusted by pen width

Hidden lines will NOT be removed

Plot will be scaled to fit available area

This is a list of the previously defined defaults. You are now able to reset one or many, or accept them as they stand. As an exercise to see what these questions are, you will answer Yes and run through the list. Some of them are pertinent to our efforts here, and some are not. If you are unsure what a question is referring to, consult the reference manuals.

Do you want to change anything? <N> Y *(for Yes)*

Entity Color	Pen No.	Line Type	Entity Color	Pen No.	Line Type
1(red)	1	0	9	1	0
2(yellow)	1	0	10	1	0
3(green)	1	0	11	1	0
4(cyan)	1	0	12	1	0
5(blue)	1	0	13	1	0
6(magenta)	1	0	14	1	0
7(white)	1	0	15	1	0
8	1	0			

Write the plot to a file? <N> Y *(for Yes)*

Size units (Units or Millimeters) <I>: I *(for Inches)*

Plot origin in Inches <0.00,0.00>: 0,0

Standard values for plotting size

Size	Width	Height
MAX	7.83	10.50

Enter the Size or Width, Height (in Inches) <MAX>: MAX

Rotate 2D plots 90 degrees clockwise? <Y> Y (for Yes)

Pen width <0.001>: .001

Adjust area fill boundaries for pen width? <N> N (for No)

Remove hidden lines? <N> N (for No)

Specify scale by entering:

Plotted Inches=Drawing Units or Fit or ? <F>: F (to Fit the drawing to the page)

Enter file name for plot <ANDO>: A:ANDOPLOT

Effective plotting area: 7.83 wide by 10.50 high

Processing vector: *(Many numbers should flash by. This is good. Consider yourself lucky. Be patient and wait a bit. There is a lot of number crunching going on while AutoCAD converts your graphics into something that the laser printer will understand. It should stop at about 1248.)*

Plot complete.

Press RETURN to continue: RETURN

You will return once again to the AutoCAD Main Menu. Exit AutoCAD by typing 0.

D. Plot the Drawing at the Laser Printer

If necessary move yourself and your diskette to a machine which is linked with a laser printer.

The following procedure is specific to the menu system currently available in the Architecture Department of Architecture at U.C. Berkeley. If you are not using a machine with this system, the following steps will probably prove irrelevant. If this is the case, refer to the printing procedures specific to your facilities.

(Turn on the computer, monitor and printer if they are not yet on. From the main menu locate the GRAPHICS menu and click on option 3 - Print an AutoCADD Plot File.)

Select the drive the plot file is on:

A: B: C:\USER

(Make sure that the A: option is highlighted and hit the RETURN key.)

Enter the full plot file name:

ANDOPLOT.PLT

Plotting File, Please Be Patient

Working ...

Eventually the following message will appear, the laser printer will gurgle a bit and your drawing will be revealed to you. If it does not, go back to page 1 and start all over. . . Only kidding. If there is a problem, talk to someone familiar with this procedure.

1 File(s) copied

Selection Completed . . Press SPACE BAR to return to AUTOMENU.

(Press SPACE BAR.)

9. DON'T GO YET!

You still need to copy your files onto your second diskette. Place this other diskette in the B: drive. Choose option 6 from AutoCAD's Main Menu to get to the File Utility Menu. Choose option 5 to copy files.

File Utility Menu

0. Exit File Utility Menu

1. List Drawing files

2. List user specified files

3. Delete files

4. Rename files

5. Copy files

Enter selection (0-5) <0>: 5

Enter name of source file: A:ANDO.DWG

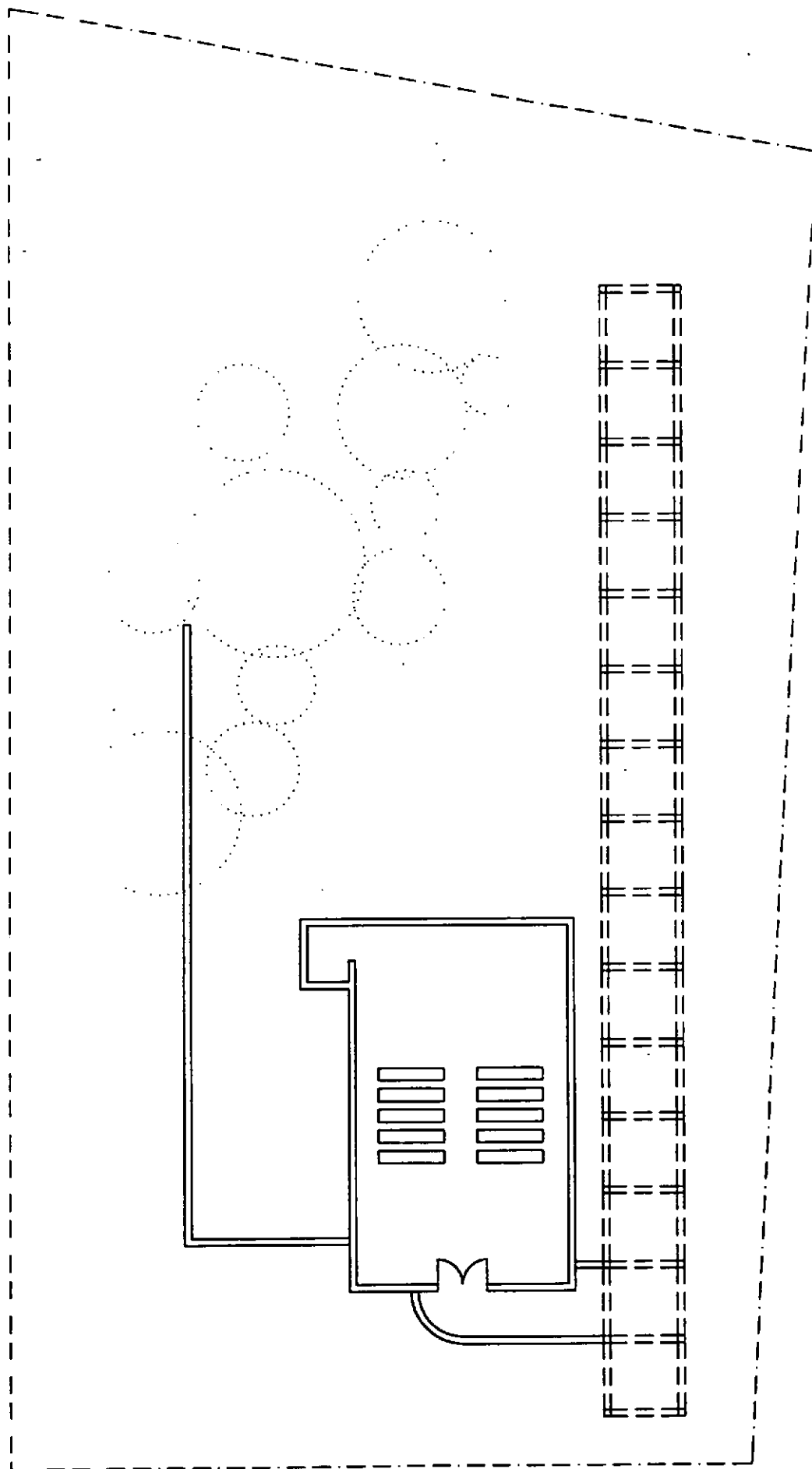
Enter name of destination file: B:ANDO.DWG

Copied #### bytes.

Press RETURN to continue: RETURN

(Hit RETURN again to exit the File Utility Menu.)

Exit AutoCAD by choosing option 0 from the Main Menu. If there is no one waiting after you to use the machine, turn off the CPU and monitor. If it appears that you are the last one to leave the room for the day, turn off the printer as well, shut the windows, turn off the lights and lock the door behind you.



Workshop G.23

Three-Dimensional Solid Modeling: Graphic Design
System

Three-Dimensional Solid Modeling: *Graphic Design System (XSOLID and XSVS)*

Objectives

1. To model architectural forms in a true three-dimensional environment by creating solid primitives and using workshop and boolean operations.
2. To learn basic commands of XSOLID-- the solid modeler of *Graphic Design System (GDS)*.
3. To learn how to assign materials to objects and surfaces, define colors for the materials, and render them in XSVS-- the solid rendering module of GDS.

This workshop assumes no familiarity with GDS or the operating system, VMS, which it uses. Also, there is no coverage of two-dimensional capabilities of GDS here. Your work, should you want to keep a copy of it, can be saved on the tape drive of your microVAX. Also, GDS User Manuals should be available near your computer. Though sometimes cryptic, they can be helpful in a pinch.

Procedure

1. The GPX Workstation

A. Log On to the MicroVAX

Make sure the power to your workstation is turned on by checking the green indicator light at the bottom right of the display. The power switch is located on the right side of the display near the bottom, together with the brightness and contrast controls.

(Move the mouse so that the cursor is near the center of the screen, then click the left button once. Position the cursor so that the option Create new VT220 window is highlighted, then click the left button once.)

Respond to the system login prompts, using the GUEST account.

Username: GUEST
Password: GUEST

For security reasons, the password you enter is not echoed on the screen.

B. The Project

For this workshop you will be modeling three buildings. Two of them, Kresge Auditorium and the MIT Chapel, were designed by the Finnish architect, Eero Saarinen. The third building, MIT's Student Center, was designed by someone who we can't seem to remember at the moment. And (surprise, surprise) they are all located on the MIT campus in Cambridge, Massachusetts. So, if you're ever in the area...

You will first create a base upon which all the buildings will sit. Then, using various modeling techniques, you will create a massing model of the group. Refer to the final page of this workshop for an image of the final model.

GDS is case sensitive, so it does make a difference whether you type "EERO" or "eero". For this reason, it is a good habit to type everything in upper case.

(Hit the Cap Lock key now.)

C. Start GDS with the Expert Menu Option

Start GDS by typing GDS at the VMS system prompt (\$). VMS is the operating system which GDS uses. At the end of the workshop, there is a brief review of helpful VMS commands.

\$ GDS

You will enter GDS using the expert user menus. By choosing this option, you will be allowed to enter GDS without specifying an existing filename (which is good, since you don't have one and don't want to create a new one).

GDS entry

<u>Options</u>	
G	-GDS starter kit (for new 2D files)
E	-expert user menu
X	-dummy graphic at VDU
I	-interactive entry
T	-Tek 4014 emulation (T4014T)
M	-Tek 4017 emulation (Mac II) (T4107)
Q	-exit to VMS

Select: **E**

drawing file name (in personal FG: directory only)
or (RETURN) for manual file selection within GDS: **RETURN**

Please wait . . .

Wait a moment while GDS sets up. Two main windows will appear on the screen and eventually some menu icons. The black window is the graphics window, the white one is the text or dialogue box. Many commands will scroll along the text screen while GDS is loading itself.

(With any mouse button, click on the white text window, henceforth known as the dialogue box. This window will pop on top of the graphics window.)

(Click on the top bar of the graphics window to pop it in front. Notice that if you click in the center portion of the graphic window, you will get an error message. This is because GDS thinks you are trying to input graphic information.)

As stated earlier, this workshop assumes no knowledge of GDS' two-dimensional drafting capabilities. All of your work will be done in the three-dimensional module, otherwise known as XSOLID. When you work in 3D your objects and data are stored in a file group called a codex file, in your FG directory. Think of a codex as a storage cabinet for all the solid pieces which you will create and work on. When you need to store objects or recall them in 3D you need to open this cabinet. You eventually may have more than one codex. If so, keep in mind that only one codex file can be open at a time.

For the entirety of this workshop, type in commands and responses as they appear in bold type. Many of these words are shown in both upper and lower case. There is a reason for this. GDS does not require you to type the entire command. You only need to type enough letters of a given command in order to make it unique. For example, if you want to use the SETUNITS command, you need only to type SETU because no other command begins with those four letters. If you only typed SET, however, GDS would not know whether you meant SETUNITS or SETOBJECT

or **SETWHATEVER**, and would alert you to the ambiguity. Though GDS will accept the entire command, you only need to type the upper case portion of the bold type commands and responses.

2. XSOLID, the 3D Module of GDS

A. Choose an Overall Size

XSOLID is the solid modeling module of GDS that lets you create objects, edit them and assign materials to them. The XSOLID command must be followed by a value for "overall size". This value controls the resolution and amount of detail of all objects modeled during a Solid Modeler session. Five ranges are available: 100, 10, 1, .1, .01 meters. Once you begin a 3D session and save objects to a codex, all future sessions must use the same overall size for that group of components. Okay, enough talk, let's get into XSOLID. For this session, you will use an overall size of 10.

```
> XSOLId
OVERALL SIZE IN METRES (100,10,1,.1,.01)? 10
Codex filegroup: None
```

The XYZ axes which appear on the screen indicate the origin (0/0/0) of your three-dimensional world. The XY plane is considered to be the working plane. The working plane acts as a temporary 2D drawing surface and is critical when you use GDS' workshop operations.

B. Create a New Codex

```
> CODex
NEW CODEX ('CREATE') or
CODEX FILEGROUP (BASE FILETITLE)? Create
CODEX FILEGROUP (BASE FILETITLE)? EERO3D
USER_DISK:[USER.A132.GUEST.FG]EERO3D.FGB;1 CREATED AND SELECTED
```

Using the CODEX command of XSOLID allows you to create a new codex file. This same command allows you to select an existing codex from which you could recall existing 3D data.

C. Set the Units

You must tell GDS what units you intend to use. As you will see, many options and variations are available with the SETUNITS command. After you input each new parameter, look at the list of options which follow. You will first indicate that feet (FT) will be your default unit. Then you will want to break these down fractionally (F) into 12 units or inches. At the bottom of your screen, below the UNITS box, you can see that the default unit is set to millimeters (MM).

```
> SETUnits
('LINEAR,MASS')? Linear
UNIT ('KM,METRE,CM,MM,MICRON,MILE,YARD,FT,IN,THOU') or
OTHER UNIT ('OTHER')? Ft
OUTPUT WITH FRACTION ('FRACTION') or
DECIMAL PLACES (0 to 5) or
DEFAULT (RETURN)? Fraction
FRACTION 1/(NO>=2)? 12
DECIMAL PLACES (NO 0 to 5) or
DEFAULT (RETURN)? RETURN
```

The current UNITS setting at the bottom of the screen should have changed to feet (FT).

D. Create a Solid with the SHAPE Command

Create a solid for the base of the site. You will call this solid SITE:01. GDS uses an object-based data structure. (This is as opposed to a layer-based system, such as AutoCAD.) An object name may consist of up to eight parts, termed facets, with colons separating adjacent facets. Each name should somehow describe the object's use in the model and should have a logic such that a group of related objects could be referred to as a whole using the wildcard option. It is good practice to keep the last facet numerical. This will be explained a bit more later on. Pay attention to the naming convention used in this workshop to get a better understanding of how this works.

The SHAPE command allows you to create one of many primitive solids. You must provide a name (in this case, SITE:01) and the desired sizing parameters.

```
> SHApe
SHAPE TYPE (CUB,CYL,CONE,SPH,PYR,TOR,HEXA)? or
OBJECT TO RECEIVE SOLID (OBJECT)? CUBoid
OBJECT TO RECEIVE SOLID (OBJECT)? SITE:01
X-SIZE (DIST)? 500
Y-SIZE (DIST)? 500
Z-SIZE (DIST)? 150
```

Because the default unit is FT, you did not need to indicate FT in the response. If you needed to specify inches as part of a dimension, the syntax would be, for example, 100F6 for 100'-6".

E. Use ALL and DRAW to View the Extents of Your Model

You will not be able to see the site cuboid right away. This is because it is much bigger than the current display setting. You need to step back a bit to get it all in the picture. The ALL and DRAW commands, used in tandem, allow you to fit all of your objects on the screen as large as possible.

```
> ALL
> DRAw
```

The XYZ axes now appear quite tiny at the center of the screen. The SITE:01 cuboid was located with the center of its bottom face resting on the working plane at the origin. Move this solid so that the top of it is actually at the normal working plane level.

```
> MOVObject
OBJECT TO MOVE (OBJECT*)? SITE:01
TRANSLATION START (XYZPOS)? or
TRANSLATION BY (BY) By
TRANSLATION VECTOR (XYZPOS)? 120/0/-150
```

```
> ALL
> DRAw
```

F. Create and Relocate Two Spheres to Begin the Auditorium

You will now create two spheres which you will use to build the auditorium. One sphere will be the shell, or roof, of the building. The second sphere, along with a cylinder and the site cuboid, will be used as tools to carve away that first sphere. The operations performed on the solids are not unlike those used in a woodshop or a model shop. Because you are able to actually carve away from and add to solids in this manner, the GDS solid modeler is a true three-dimensional environment. As you continue with this workshop, compare this to a surface modeling environment if you are familiar with one, such as AutoCAD.

```
> SHApE
SHAPE TYPE ('CUB,CYL,CONE,SPH,PYR,TOR,HEXA')? or
OBJECT TO RECEIVE SOLID (OBJECT)? Sphere
OBJECT TO RECEIVE SOLID (OBJECT)? AUDIT:01
RADIUS (DIST)? 100
```

This may take a few seconds. Please be patient.

GDS allows you to input all the parameters for a given command on one line. This way you won't have to hit the RETURN key after every command and subcommand response. You will create the second sphere using this technique. Remember that you must know what the prompts will be for that certain command ahead of time. In the case of the shape command, we must first tell GDS that we want a sphere, that it will be called AUDIT:02, and that it will have a radius of 98'-6". Separate each of the parameters with one and only one space. At the end of the line hit the RETURN key.

```
> SHApE Sphere AUDIT:02 98F6
```

Both spheres are sitting on the XY working plane at the origin. In order to make them concentric, use the MOVObject command to relocate the smaller one 1'-6" in the positive Z direction. Note that the syntax for XYZ positions in GDS' 3D module: Xvalue/Yvalue/Zvalue.

```
> MOVObject
OBJECT TO MOVE (OBJECT*)? AUDIT:02
TRANSLATION START (XYZPOS)? or
TRANSLATION BY ('BY') By
TRANSLATION VECTOR (XYZPOS)? 0/0/1F6
```

Use the same command to properly locate both spheres on the site. The wildcard option, **, is appropriate here to move both AUDIT:01 and AUDIT:02.

```
> MOVObject AUDIT:** By 0/100/-150
```

G. Some GDS Viewing Techniques

Take a moment to see how the GDS defines a curved solid. Each of these spheres is actually a collection of facets. The resolution factor of 10 which you set up as you entered XSOLID decides how refined these facets will be.

```
> SHOW
TYPE OF LINE ('CONSTRUCTION, FACETS')? Facets
DRAW ('YES,NO')? Yes
> DRaw
```

Having these facets visible can be annoying as it slows down the redraw time and can create difficulties in viewing. You should turn them off. Use the same command, this time all on the same line.

```
> SHOW Facets No
> DRaw
```

It may be useful to alter the hidden line mode. Currently there are no hidden lines. The HIDE command gives us three options.

```
> HIdE
HIDDEN LINE MODE ('YES, DOTTED, NO')? Yes
> DRaw
```

The intersecting edges of the sphere and the cuboid are not rendered. Now try the DOTTED mode.

Note how you must use the DRAW command to display the viewing changes that were just input. Remember this when you are sitting in front of the screen wondering why nothing is happening after you just told GDS to do something. For awhile, keep it in HIDE DOTTED mode.

```
> HIDE DOTTED
> DRAW.
```

H. Current Object, Tools and Boolean Operations

An important component of XSOLID is its ability to perform boolean operations which include the addition, subtraction and intersection of prescribed solids. In order to use any of these operations (ADD, INTERSECT or REMOVE), there are two objects of which you must be acutely aware.

1. The Current Object: This is the object upon which you will act. It is set using the SETOBJECT command. The current status is displayed in the lower right part of the screen under the OBJECT box.
2. The Tool: This is the object used to alter the current object.

In this case, the sphere (AUDIT:01) will be set as the current object. SITE:01 will be the tool and will be used to carve away that part of the sphere which is not needed.

```
> SETObject
CREATE NEW OR SELECT EXISTING (OBJECT)? AUDIT:01
Object AUDIT:01 selected.
```

```
> REMOVE
OBJECT TO REMOVE (OBJECT)? SITE:01
SITE:01 removed.
```

Now use the REMOVE command again to carve out the larger sphere with the smaller sphere. This will result in a shell 1'-6" thick. AUDIT:01 is still the current object. This time the tool will be AUDIT:02, the smaller sphere.

```
> REMOVE AUDIT:02
```

This operation takes a few minutes. While it's doing some number crunching, think about what the result will be. You just removed the tool, AUDIT:02, from the current object, AUDIT:01. That means the smaller sphere will be used to carve out the larger sphere leaving you with a shell. This is the roof of the auditorium.

Now remove that part of the smaller sphere which intersects with the site cuboid. You will need to set a new current object.

```
> SETObject AUDIT:02
> REMOVE SITE:01
SITE:01 removed.
```

I. Create Another Tool to Further Carve Away at the Auditorium

```
> SHApe
SHAPE TYPE (CUB,CYL,CONE,SPH,PYR,TOR,HEXA)? or
OBJECT TO RECEIVE SOLID (OBJECT)? CYLinder
OBJECT TO RECEIVE SOLID (OBJECT)? TOOL:AUDIT:01
RADIUS (DIST)? 200
Z-HEIGHT (DIST)? 200
```

Another feature of GDS is that the previous command is implied. This means that if you type CYLINDER again on the next line (or any of the primitive solids available with the SHAPE

command), GDS will assume you want to repeat the SHAPE command. This way you do not need to repeatedly type in the same command. It is only a slight savings in keystrokes, but it can become convenient at times. Try it here.

```
> CYLinder TOOL:AUDIT:02 150 250
> SETObject TOOL:AUDIT:01
> REMOve TOOL:AUDIT:02
```

Use the DELOBJECT command to get rid of the smaller cylinder since we only needed it to carve a hole out of the larger cylinder.

```
> DELObject TOOL:AUDIT:02
> MOVOBJECT TOOL:AUDIT:01 By 0/0/-150
```

I. View Your Model Using an Orthogonal View

The default viewing setup in XSOLID is an isometric one. You can also view your model orthogonally using the ORTHO command. Oddly enough, in order to see the options available with ORTHO you must type in some mumbo jumbo on the same line as the command. GDS will then tell you that you made a mistake and will ask for input which might make sense. Humor it by then inputting one of the valid options of which it provides a list. Note that the default options is TOP.

```
> ALL
> ORTho MUMBO
    MUMBO SYNTAX?
    PRINCIPAL VIEWBOX FACE (TOP,BOTTOM,RIGHT,LEFT,FRONT,BACK) or
    DEFAULT TOP (RETURN)? Front
> DDraw

> ORTho
> DDraw
```

This default TOP view will help you, hopefully, to understand the purpose of the cylinder solid in carving away more of the auditorium. In the following sequence with the MOVOBJECT command, note another technique for saving keystrokes. You can use C to indicate that you want to act on the Current object. Otherwise you would need to type in the entire name. Yes, this only works if the current object is the one you want to act on.

```
> MOVOBJECT
    OBJECT TO MOVE (OBJECT*)? Current
    TRANSLATION START (XYZPOS) or
    TRANSLATE BY (BY)? By
    TRANSLATION VECTOR (XYZPOS)? 0/185/0

> SETObject AUDIT:01
> REMOve TOOL:AUDIT:01

> SETObject AUDIT:02
> REMOve TOOL:AUDIT:01
```

K. Move the Working Plane Origin with the PLANE Command

```
> PLane
    RESET working-plane (NOR,HOR,SHI,ROT,TWI,FLI,LOC,TIL,CIR)? Shift
    NEW ORIGIN (XYZPOS)? 0/100/0
```

This relieves us from figuring out geometrically how to move the tool cylinder into the proper location for the next REMOVE operation. You will rotate the cylinder about the new Z axis.

L. Use the ROTObject Command to Relocate an Object

The following set of commands continues to manipulate the large cylinder around the spherical shell so that the proper sculpture can be made. Most of the work involves knowing which solid is current (to be cut) and which is the tool.

```
> ROTObject
OBJECT TO ROTATE (OBJECT)? TOOL:AUDIT:01
ROTATE ABOUT LINE (XYZPOS)? or
ROTATE ABOUT AXIS ('X,Y,Z')? Z
ROTATE FROM (XYZPOS)? or
ROTATE THROUGH (ANGLE)? 120

> REMOve
OBJECT TO REMOVE (OBJECT)? TOOL:AUDIT:01

> SETObject AUDIT:01
> REMOve TOOL:AUDIT:01

> ROTObject TOOL:AUDIT:01 Z 120
> REMOve TOOL:AUDIT:01

> SETObject AUDIT:02
> REMOve TOOL:AUDIT:01

> DELObject TOOL:AUDIT:01
```

M. Return to the Default View (ISO)

```
> ISOmetric
> ALL
> DDraw
```

N. Use Construction Lines to Draw a Partial Section of the Chapel

```
> PPlane Normal
```

This brings the working plane back to its original position. From here relocate it to the center of the chapel location. Then draw a cross-section of the chapel and moat which you will revolve about an axis in order to create the new solid. Trust me.

```
> PPlane Shift -70/-120/0
> ORTho
> DDraw
```

(Click on the small white icon at the upper left corner of the black graphics window. Choose the Additional Options by clicking on that line. Then choose the Change Window Extents option by clicking on it. Click and drag two points in the graphics window as shown in order to "zoom in" on a smaller portion of your model. This will give you a clearer idea of what's going on.)

```
> LIne
POINT (XYZPOS)? 0/0/0
POINT (XYZPOS)? R0/R35/R0
POINT (XYZPOS) or
CANCEL LAST POINT ('BACK') or
JOIN TO FIRST POINT ('CLOSE') or
END (RETURN)? R27/R0/R0
R0/R1/R0
R1/R0/R0
R0/R-35/R0
```


R4/R0/R0
R1/R1/R0
R0/R1/R0

R1/R0/R0
R0/R-4/R0
R-34/R0/R0

POINT (XYZPOS) or
CANCEL LAST POINT ('BACK') or
JOIN TO FIRST POINT ('CLOSE') or
END (RETURN)? Close

(The small menu at the upper left of the screen should still be visible. This time click on Include Whole Scene.)

Q. Rotate the Construction Line into the Proper Orientation

C-lines are construction lines, which can represent cross-sections, centerlines or the linear components of a model. C-lines can be any combination of straight lines and arcs. C-lines are also used for sweeping paths, loops for extrusion or skinning, and as vectors for moving and repeating objects. In this example, the c-line is a partial cross-section of the chapel which can be rotated about a desired axis.

> ROTCline
C-LINE TO ROTATE (XYZPOS)? *(With the center mouse button, click on any segment of the c-line just created.)*
ROTATE ABOUT LINE (XYZPOS)? or
ROTATE ABOUT AXIS (X,Y,Z)? X
ROTATE FROM (XYZPOS)? or
ROTATE THROUGH (ANGLE)? 90

> ISometric
> DDraw

P. Use a Workshop Operation (REVOLVE) to Create a Solid

> REVolve
OBJECT TO RECEIVE SOLID (OBJECT)? CHAPEL:01
C-LINE LOOP (XYZPOS)? *(Click again on the c-line with the middle mouse button.)*
REVOLVE ABOUT LINE (XYZPOS)? or
REVOLVE ABOUT AXIS (X,Y,Z)? Z
ROTATE FROM (XYZPOS)? or
ROTATE THROUGH (ANGLE)? 360

Q. Complete the Chapel's Main Components

Now add the wall which runs along an adjacent alley. First shift the working plane to a more convenient location.

> PLane Shift 0/-72/0
> SHApe CUBoid WALL:01 90 2 14

(Zoom in again on the chapel and wall using the small menu at the upper left of the screen. Click on Additional Options and then Change Window Extents.)

> PLane Shift 0/23/0
> SHApe CUBoid ENTRY:01 10 45 1

> SETObject ENTRY:01
> MOVObject Current By 0/0/2F6

> REPObject
 OBJECT TO MOVE (OBJECT*)? Current
 TRANSLATION START (XYZPOS)? or
 TRANSLATION BY ('BY') By
 TRANSLATION VECTOR (XYZPOS)? 0/0/9

R. Inquire for Information Regarding an Object

> QUery
 QUERY OBJECT (OBJECT)? *(Click on the upper planar solid just created with the middle mouse button to confirm that the solid created during the last command was named ENTRY:02.)*
 ENTRY:02
 Object has a solid
 Object has no c-lines
 Object material: Surface material:

 > REMOve CHAPEL:01
 > WALL:01

 > SETObject ENTRY:02
 > REMOve CHAPEL:01
 > WALL:01

(Click on Additional Options and Include Whole Scene off the upper left menu if necessary.)

S. Use More Workshop Operations to Build the Student Center Building

While working on the Student Center do not hesitate to use the menu at the upper left of the graphics window to zoom in and out of your drawing. Just click on the icon, choose *Additional Options*, then choose either *Change Window Extents* or *Include Whole Scene*.

> ORTho
 > DRaw

 > PLane Shift 180/-44/0

Draw two construction lines, one for the plinth of the Student Center and one representing in plan the main body of the building.

> SETObject CLINE:01

 > LIne
 POINT (XYZPOS)? 0/0/0
 0/260/0
 190/260/0
 190/0/0
 Close

 > PLane Shift 60/55/0

 > LIne
 0/0/0
 0/165/0
 90/165/0

 90/-15/0
 0/-15/0
 0/0/0
 RETURN

Use the QUERY command to make sure that the c-line just created is an open line.

```
> QUery
QUERY OBJECT (OBJECT)? (Click on the c-line just created with the middle mouse button.)
CLINE:01 (Current object)
Object has no solid
Object has c-lines
C-loop identified is open with 6 vertices
C-loop is planar
```

Draw another c-line which will be the cross-section of the outer shell of the Student Center.

```
> LIne
0/15/0
R0/R50/R0
R-8/R0/R0
R0/R5/R0

R-2/R0/R0
R0/R-15/R0
R-13/R0/R0
R0/R4/R0

R-2/R0/R0
R0/R-29/R0
R15/R0/R0
R0/R-15/R0
Close
```

Rotate the c-line to a vertical position.

```
> ISOmtric
> ALL
> DDraw

> ROTCline
C-LINE TO ROTATE (XYZPOS)? (Click on the last c-line drawn with the middle mouse button.)
ROTATE ABOUT LINE (XYZPOS)? or
ROTATE ABOUT AXIS (X,Y,Z)? X
ROTATE FROM (XYZPOS) or
ROTATE THROUGH (ANGLE)? 90
```

Now use the workshop operation SWEEP to create a solid which models the exterior shell of the Student Center.

```
> SWEEP
OBJECT TO RECEIVE SOLID (OBJECT)? STUD:01
POINT ON SPINE NEAR START (XYZPOS)? (Click on the smaller rectangle with the middle mouse button.)
SCALING (DECIMAL) or
MAIN LOOP (XYZPOS)? (Click on cross-section to be swept with the middle mouse button.)
HOLE (XYZPOS)? or
(RETURN)? RETURN
```

You now need to close that main (rectangular) loop in order to extrude it vertically. Use the JOIN command for this. First turn the visibility of STUD:01 off so it will be easier to pick points.

```
> VISObject
SET VISIBILITY (OBJECT)? STUD:01
VISIBLE (YES,NO)? No
```

> Join
 FIRST C-LINE NEAR END (XYZPOS)? *(Click at point A with middle mouse button.)*
 SECOND C-LINE NEAR END (XYZPOS)? *(Click at point B with middle mouse button.)*



Query on the same c-line to make sure it is now closed.

> Query
 QUERY OBJECT (OBJECT)? *(Click on c-line just joined to itself with the middle mouse button.)*
 CLINE:01 (Current object)
 Object has a solid
 Object has c-lines
 C-loop identified is closed with 5 vertices
 C-loop is planar

Extrude two c-lines in order to create the plinth and the main body of the Student Center.

> EXTrude
 OBJECT TO RECEIVE SOLID (OBJECT)? STUD:02
 EXTRUDE BY (BY)? or
 EXTRUSION START (XYZPOS)? By
 EXTRUSION VECTOR (XYZPOS)? 0/0/65
 MAIN LOOP (XYZPOS)? *(Click on smaller of two rectangles.)*
 HOLE (XYZPOS)? or
 (RETURN)? RETURN

> EXTrude STUD:03 By 0/0/-3
 MAIN LOOP (XYZPOS)? *(Click on larger of two rectangles.)*
 HOLE (XYZPOS)? or
 (RETURN)? RETURN

> VISObject STUD:01 Yes
 > MOVObject STUD:** By 0/0/3

(If necessary click on Include Whole Scene of the Additional Options on the graphic screen menu.)

T. Control the Visibility of Construction Lines

Turn the c-lines off with the VISCLINE command.

> VISCLine
 SET C-LINE VISIBILITY OF (OBJECT)? **
 VISIBLE (YES,NO)? No

U. View Your Model in Perspective Mode

You can also view your three-dimensional environment in a perspective mode, either one-, two- or three-point. Change your view to a three-point perspective with the PERSPECTIVE command. Similar to the ORTHO command you must type in some mumbo jumbo after the command in order for GDS to tell you your options.

> HIdE Yes
 > PERSpective MUMBO
 SET VIEWPLANE (1-PT,2-PT,3-PT)? or
 VIEWPLANE UNCHANGED (RETURN)? 3-pt
 > DRAw

V. Move Around in the 3D Environment

It is about time for you to get another vantage point of this model. Two very useful commands for

moving around your three-dimensional environment are EYE and LOOK. As you might have guessed, the EYE command lets you alter the location of the eyepoint, and the LOOK command lets you change the location of the point you are looking at. First try the EYE command.

```
> EYE
NEW EYE POSITION (XYZPOS) or
EYE RAY THROUGH (THROUGH) or
RESCALE EYE RAY LENGTH BY 1: (DECIMAL) or
MOVE EYE TO SEE (BOX,ALL) or
ROTATE EYE RAY (WHEEL,ROUND) or
SET ZOOM ANGLE (ZOOM)? Round
ROTATE THROUGH (ANGLE)? 190
```

As you can see from the list of options provided, there are many ways to use the EYE command. For now you will only be concerned with the ROUND, WHEEL and rescaling options. EYE ROUND moves your eyepoint while the lookpoint and length of eye ray remain constant. The direction of positive rotation follows the right-hand rule. So, with the positive Z axis pointing up (that's your right thumb), positive 190 degrees, will swing you around in the direction of the rest of your right hand fingers. Use the DRAW command to implement the EYE command parameters just entered.

```
> DRAw
```

EYE WHEEL also keeps the lookpoint and eye ray length constant. With this option the eyepoint swings up and down. A negative value swings you down, or closer to the ground, by a given number of degrees.

```
> EYE Wheel -20
> DRAw
```

The EYE command followed by some decimal fraction rescales the eye ray length so that you are essentially standing closer or farther away from the objects. In the following example, you cut the eye ray length in half, so the buildings will appear half as far from (or twice as close to) the observer.

```
> EYE .5
> DRAw
```

W. Assign Materials to Objects and Surfaces

You will assign materials to certain objects in XSOLID. Then when you enter XSVS (GDS' rendering module), you will connect colors to objects via these material assignments. Use the MATOBJECT command to assign the materials.

```
> MATObject
MATERIAL (MATERIAL)? BRICK
SELECT OBJECT (OBJECT*)? CHAPEL:01
```

Notice that you get a message saying that MATERIAL:BRICK does not exist in codex... This just means that this is the first time definition for the material "BRICK". The message is just letting you know that there are no other materials in the codex with that name.

Use the MATOBJECT command and assign materials to the rest of the objects. Remember that if you are repeating a command (MATOBJECT, in this case) it is implied by GDS that you will use the previous command used.

```
> MATObject BRICK WALL:01
> METAL ENTRY:**
> COPPER AUDIT:01
```

```
> GLASS AUDIT:02
> GROUND SITE:01
> CONCRETE STUD:**
```

Swing up with the EYE WHEEL option and then zoom in with the *Additional Options* to get a better view of the water in the moat.

```
> EYE 2
> EYE Wheel 45
> DRaw
```

(Use the Additional Options and the Change Window Extents to zoom in on the chapel.)

```
> MATSurface
MATERIAL ('TRANSPARENT,BACKGROUND' or MATERIAL)? WATER
SURFACE (XYZPOS) or
(ALL)? (With the middle mouse button, click very close to the bottom line of the main cylinder
making sure that you are on the water surface, not the vertical side of the chapel. You must
be precise for this hit.)
SURFACE (XYZPOS)? or
(RETURN)? RETURN
```

```
> MATSurface CONCRETE
SURFACE (XYZPOS) or
(ALL)? (With the middle mouse button, click on the roof of the chapel close to but not on the
parapet wall.)
SURFACE (XYZPOS) or
(RETURN)? RETURN
```

(Click on the Include Whole Scene of the Additional Options of the graphic screen menu.)

X. Save the Objects and Exit from XSOLID

Before you exit XSOLID, you need to save all the components that were created. And before you save the components, you must set your working plane back to the normal position. If you do not, the management will not be held responsible for objects that appear to be flying around when you re-enter XSOLID and recall your objects.

```
> PLane Normal
> SAVE
OBJECT TO BE SAVED (OBJECT*) or
VIEWING PARAMETERS ('VIEWING')? **
Component TEMP:01 created in codex.
Component ENTRY:01 created in codex.
...
...
...
Component SITE:01 created in codex.
```

Wait until GDS lists all the solids as each is saved in the codex. Then exit.

```
> EXIT
```

3. XSVS, the Solid Viewing System of GDS

A. Recall the Objects that were Saved in the EERO3D Codex File

You have just completed creating your 3D model and will now render it. XSVS is the solid viewing system of GDS that enables you to render your images by assigning colors to the materials specified in

XSOLID. There is also a wide variety of viewing commands in XSVS for looking at the model.

Enter XSVS and recall all the solids which you saved in your EERO3D codex file. Use the ALL and DRAW commands to view your work.

```
> XSVS
Codex filegroup: USER_DISK:[USER.A132.GUEST.FG]EERO3D.FGB;1

> RECall
MODE ('SOLIDS,CLINES,BOTH') or
RECALL (COMPONENT*)? Solids
RECALL (COMPONENT*)? **
AUDIT:01 created.
AUDIT:02 created.
...
...
...
WALL:01 created.

> ALL
> DDraw
```

Notice that the view you see is just a typical wireframe view similar to the view in XSOLID.

B. Render Some Monochrome Views

There are many different viewing options in XSVS. Use the HIDE command and create a non-colored hidden-line view of your objects.

```
> HIDE
HIDDEN LINE/SURFACE REMOVAL ('YES,BACK_FACES,NO')? Yes
ALGORITHM ('PAINTER,HIDDEN_LINE,DOTTED,SCANLINE') or
(RETURN)? Hidden_line
> DDraw
```

C. Render the Edges of the Solids

One of your options in XSVS is to render your edges so that you have a little more definition between objects. This is especially helpful when you are only using one color, but it tends to make your model look a bit cartoonish. If you have time during this work session, render the hidden lines as indicated below. If you are running a little behind, continue with section D.

```
> RENDER
FOR LINE DRAWINGS ('OBJECT_COLOURS') or
FOR HIDDEN_LINE ('INTERSECTION_EDGES') or
FOR HIDDEN_SURFACE ('EDGES') or
FOR SCANLINE ('SMOOTH,SHAD, SPEC,HALF,DITHER')? Edges
USE TECHNIQUE ('YES,NO')? Yes
> DDraw
```

Notice the edges of your objects are outlines.

D. Save a Snapshot Image of the Displayed View

Use the ZVSSAVE command to save the image on the screen as a bit map. Direct this file, and all saved views, to the CF (character file) directory.

```
> ZVSSave
SAVE FILE NAME (FILETITLE)? CF:SIMPLE
```

E. Use the Scanline Algorithm to Cast Shadows on the Model

When you do a scanline image, GDS "throws up" an additional window that is used for scanline images. It usually takes anywhere from a few seconds to an hour or more to produce a scanline image. This all depends on many factors, including the number of light sources, complexity of model and-view, choice of color map, and so on. You will know the machine is working because the image will slowly be unveiled on the screen. The shadows are cast according to the position of the sun which will be discussed briefly later.

- > RENDer SHadows Yes
- > RENDer Edges No
- > HIdE Yes Scanline
- > DRAw

F. Define Color for the Materials

XSVS allows you to assign colors using the HLS color model. This means that you will specify a hue, lightness and saturation for each material you previously assigned to an object. The hue is picked from the color wheel. Then you can further refine a color by indicating a desired lightness and saturation.

Use the HIDE NO option to get rid of the scanline window. Use the PALETTE command to assign colors to the materials of your object. The colors are up to you.

- > HIdE No
- > PALETTE
- (Click on a hue which you think is appropriate for a red brick.)*
- (Click on a more refined color.)*
- (Click on the square that says MATCH.)*

Notice that all of your material names are the same color as the default color.

- (Click on the area that has the material name BRICK.)*
- (Click on the circle option to return to the main palette.)*

Repeat the color assignment until you have defined colors for all your materials. Use a greenish-grey for the METAL, a light aqua-green for the COPPER, a dark blue for GLASS, a light/bright blue for the WATER, a concrete gray color for CONCRETE and a chipboard grey-green for the GROUND. Or... use any colors you want.

(When you are finished going back to the palette and assigning colors, click on the FINISHED box.)

G. Render the Color Shaded View

Use the painter algorithm to render this view.

- > ALL
- > EYE .5
- > EYE Round -45
- > PERSpective 3
- > HIdE Yes Painter
- > DRAw

H. Render Realistic Shadows by Manipulating the Sun's Location

Locate the "sun"— the major light source with the SUN command to render realistic shadowed images. The azimuth angle is measured from zero at the positive Y-axis. The altitude is measured from zero at the horizontal, or XY working plane.

Render a shadowed scanline morning view. Adjust the sun accordingly.

```
> SUN
BEARING MODE (RELATIVE,NORMAL)? Normal
CLOCKWISE BEARING (ANGLE)? 225
ALTITUDE (ANGLE)? 25
```

```
> RENDER SHadows Yes
```

```
> EYE 1.5
> Hide Yes Scanline
> DDraw
```

This takes about 3 minutes to draw. If you have time, create a shaded view for the evening sun.

```
> SUN Normal -20 25
> DDraw
```

This will take 5 to 7 minutes.

I. Use ZVSSAVE RASTER to Save Scanline Images

Save this scanline image using the ZVSSAVE command. In order to save a scanline, you must indicate that you want to save a RASTER file. Also use the CF: prefix to direct the file to your CF directory. The file extension for this image will be .BDR as opposed to .BDF for a non-scanline image. *Warning:* If you try to save a *scanline* image without using the *RASTER* option, the next time you recall that image you will only see a black screen.

```
> ZVSSave Raster
SAVE FILE NAME (FILETITLE)? CF:EVENING
```

J. Recall Saved Images

Make sure that your files will be recalled properly. Use the ZVSRECALL command.

```
> ZVSRecall
RECALL FILE NAME (FILETITLE)? CF:SIMPLE
TITLE FOR WINDOW (TEXT) or
DEFAULT TITLE (RETURN)? RETURN
```

Hopefully the first image you saved will fill the screen. The title of the window should be RECALLED GRAPHICS which is the default. Now recall the scanline image.

```
> CF:EVENING
```

K. Exit the XSVS Module

```
> EXIt
ARE YOU SURE (YES,NO)? Yes
```

4. Some Basic VMS Commands

A. Get a Listing of Your Directories

Open a new VMS window by clicking on the main screen background. Click on *Create new VT200 window*. Login again as GUEST and wait for the VMS prompt (\$). First request a directory listing with the DIR command.

\$ DIR

You will see a number of directories named something like FG, CF, MON and maybe more. You can get a listing of any of these directories by specifying it explicitly.

B. List the Files of a Specific Directory**\$ DIR FG**

Your codex file, EERO3D, should be listed here.

C. Change Directories

To change directories, use the SET DEFAULT command. Switch into the CF directory, then get a listing of the files. Compare file sizes of the raster image (EVENING.BDR) and the simple painter image (SIMPLE.BDF).

```
$ SET DEFault CF
$ DIR
```

D. Delete a File

In order to clear space in your account, you often need to delete some files. Use the DELETE command as follows.

```
$ DELete CF:*.BD*;1
```

The last command deleted all version 1 files with a .BD* extension from the CF directory. The version number follows the semi-colon in any filename. Now move back to the home directory, again using the SET DEFAULT command.

```
$ SET DEFault [-]
```

E. Obtain Information about Available Space on the Machine

Use the SHOW command.

```
$ SHOW DEvIce DU
```

The number next to the GDSDISK (that's you) indicates the number of free blocks that are available on your machine. As you continue to use GDS, you will become familiar with how many free blocks is necessary to perform certain tasks.

F. Log Out of the New Window

```
$ LO
```

G. Ending Your Session

There are three options from which you can choose to exit GDS: BACK, SECURE and CLOSE.

BACK: This command removes all changes made to filegroups since they were last made secure. It provides the mechanism for discarding all the changes made during the current session, and for undoing any operation which would be irreversible if filegroups were "secured" instead.

CLOSE: Filegroup updates made during this session are held in limbo, being neither discarded nor made permanent. The filegroups must be reopened at the beginning of the next session, using a special series of commands, and the updates made in this session can be either saved or disposed of then.

SECURE: Filegroup updates are saved into your main drawing file and then the temporary file which holds your edits during a work session is deleted. They cannot subsequently be removed by errors, by the BACK option, or by most system crashes. Basically, after you have secured, you are stuck with your changes for better or for worse (usually better!!). You can only undo them by redrawing them differently. SECURE is the option you will normally use.

Since we do not want you to save your work, use the BACK option. Then log off the machine with the same LO command.

```
> *Exit  
EXIT OPTION (BACK,CLOSE,SECURE)? Back
```

This can be abbreviated and done in one line (*E B) or, like all of these commands, can be selected from the onscreen menus.

\$ LO

Congratulations!! Another GDS encounter has come to a close. Please enjoy yourself until next time. You will be back, won't you?

